



RAILWAY SIGNAL APPLIANCES

GENERAL RAILWAY SIGNAL COMPANY

G·R·S
RAILWAY SIGNAL
APPLIANCES



G-R-S Type SA searchlight signals in automatic block territory.

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APPLIANCES

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GENERAL RAILWAY SIGNAL COMPANY

P. O. BOX 600, ROCHESTER 2, NEW YORK, U. S. A.

Telephone: GEnesee 1483

Cable Address: GENRASIG, Rochester, N. Y.

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INTRODUCTION

G-R-S signaling appliances embody the experience of a half century in the railway signaling field.

Each G-R-S appliance is designed, manufactured, and inspected with a single purpose in mind - to give dependable performance in railway signaling circuits.

G-R-S appliances are in successful operation in every climatic condition from subarctic cold to equatorial heat, from desert aridity to tropical humidity, from the salt air of the seacoast to the corrosive atmospheres of highly industrialized areas.

G-R-S appliances continue to operate reliably under the pounding of the world's heaviest locomotives and fastest trains, under excessive vibration encountered on bridge structures and unstable subsoils, and in spite of attacks by insects and fungus growths.

Special attention is always given to features that simplify installation, maintenance, and inspection procedures. Detailed literature, in the form of handbooks and data sheets, is available to give you full installation, operation, and maintenance information. Ask your G-R-S representative, addresses on page 88, for more specific data on any appliance described herein.

For brief descriptions of the principal G-R-S signaling systems, ask for Pamphlet 750.



PANEL 3

PANEL 2

PANEL 1

V
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T
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INDICATION UNIT 4

STEPPER UNIT

RELAYS

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RAILWAY SIGNAL APPLIANCES

RELAYS

G-R-S builds a complete line of relays for all kinds of railway signaling circuits. In this brief section you will find relays for operation on alternating or direct current, for track or line circuits, for communication or vital safety circuits. You will also find relays which are equipped with binding posts (Type K) or which are plugged onto plugboards (Types A and B). So many and varied are the characteristics of G-R-S relays that it is almost impossible to list them in the brief space of this pamphlet. If you have a particular application in mind, please consult your local representative.

TYPE K RELAYS

You can use Type K relays in any railway signaling circuit designed for d-c. operation. By adding a small rectifier, which can be attached directly to the relay, you can operate any Type K neutral relay from a.c.

The smallest Type K relay, the Size 2, has two contact fingers. Each finger has a front and a back contact. Thus a Type K, Size 2 relay can be used to control two separate circuits. Larger sizes have 4, 6, or 8 contact fingers.

Low contact resistance is secured by the use of articulated contact fingers and contacting surfaces of 99.9 percent pure silver in fingers and back contacts. The non-fusing front contacts are silver-impregnated carbon. For opening heavy-current d-c. circuits, contacts are supplied with permanent magnet blowouts that immediately disrupt any arc that may form across the gap of an opening contact.

A substantial armature torque of 18 inch-ounces (in sizes 4, 6 and 8 relays) insures positive opening of the front contacts by gravity when the relay is deenergized.

RELAYS

Contacts and armature structure are fully visible through a transparent glass cover, which is sealed to keep out dirt and moisture.

All Type K relays have easily accessible coil and contact connections with standard A.A.R. No. 14-24 binding posts. Binding post connections are plainly marked on the nameplate.

If you wish to change the operating characteristics, you can change

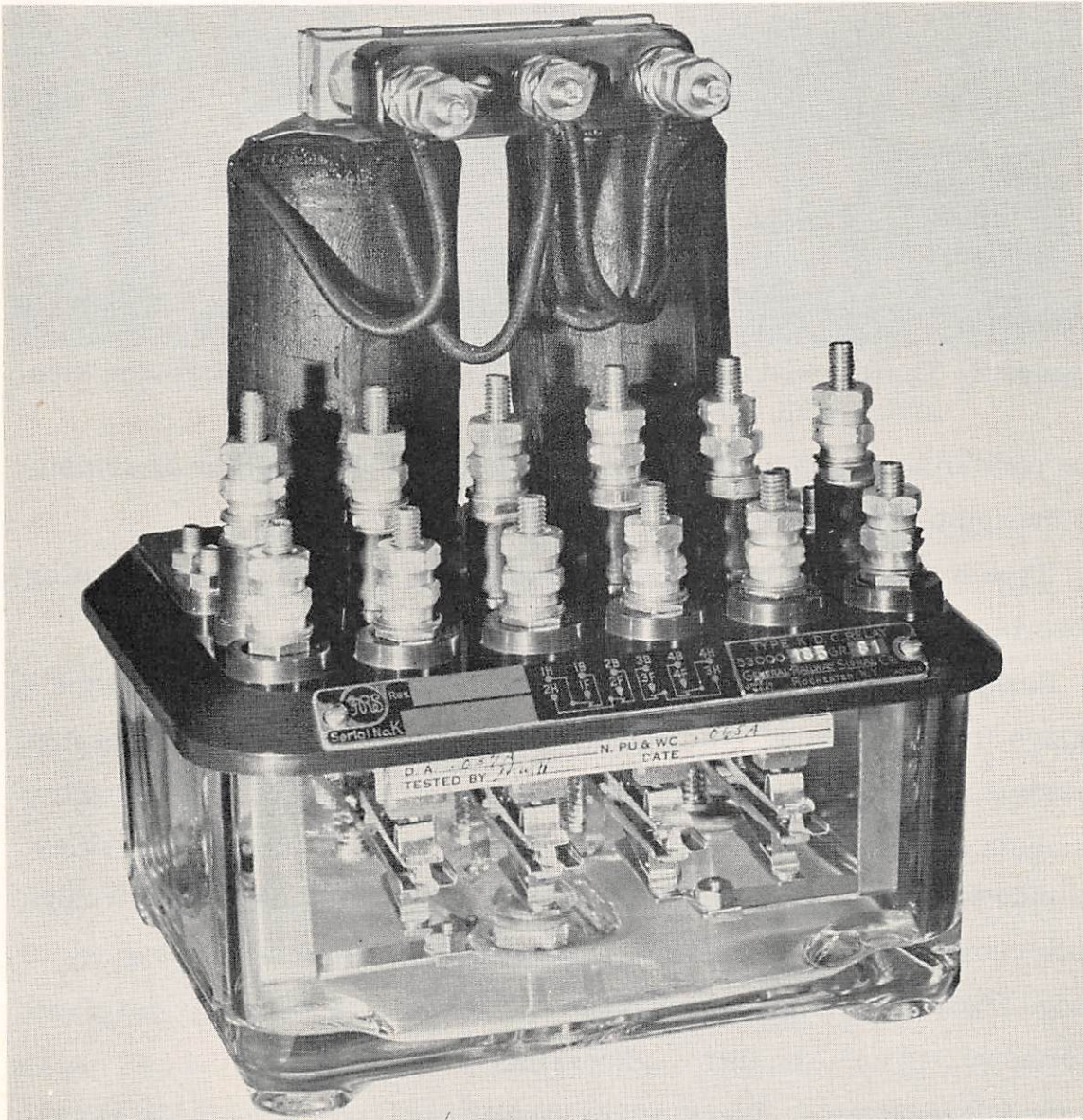


Figure 1. Type K, Size 4, neutral relay.

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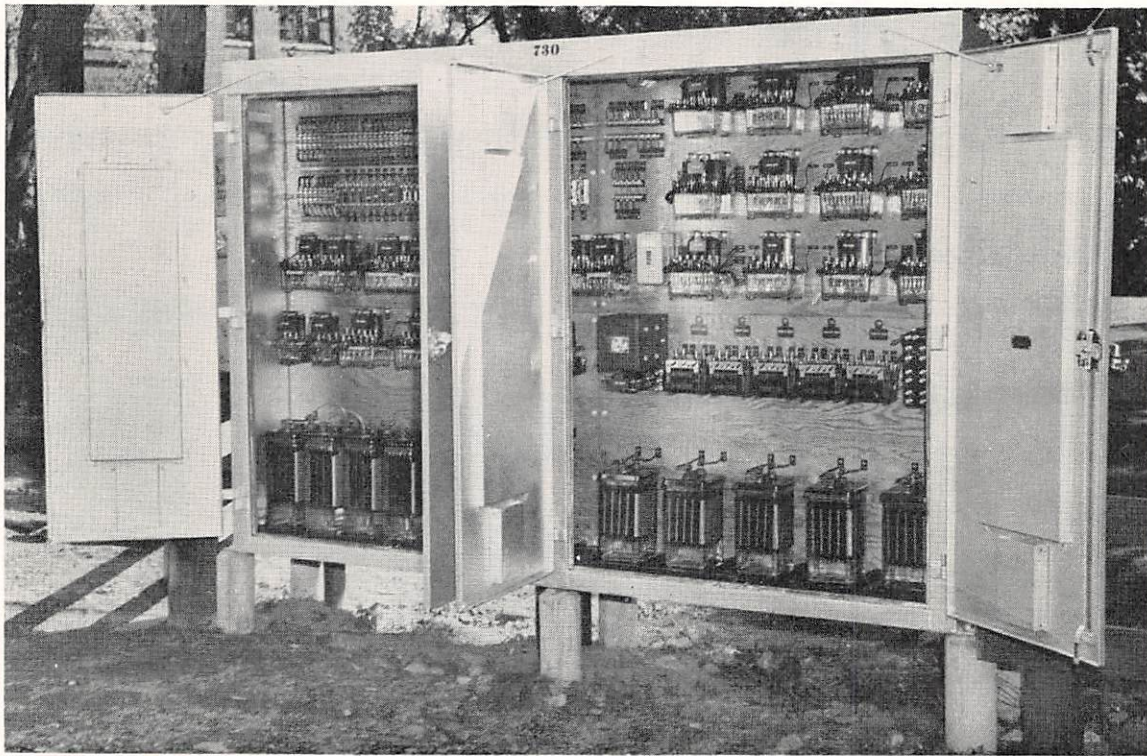


Figure 2. Typical installation of Type K relays in G-R-S welded steel instrument case.

the coils from series to multiple connection, or add a rectifier or resistor to the coil terminal block.

Type K relays can be wall or shelf mounted, with or without vibration-absorbing springs.

Besides neutral relays with normal or special operating timing, Type K relays are also supplied with polarized structures. When desired, neutral armatures on polarized structures can be so arranged as to keep neutral contacts closed during normal pole changing time. Specialized K relays include interlocking and flashing relays for highway crossing circuits, motor-operated time-element relays, relays especially designed for coded track circuits, and many other special types particularly developed for the varied and exacting requirements of signaling practice, as shown in the following table. Track relays usually have coils of very low resistance; line relays have high resistance.

RELAYS

USE AND DESCRIPTION		Available Sizes			
		2	4	6	8
Neutral, track		x	x	x	
Neutral, line, (slow release, slow pickup, or slow pickup and release)			x	x	x
Biased-neutral, line		x	x	x	x
Magnetic-stick, line			x		
Approach-lighting		x	x		
Primary-secondary, track	Primary	x			
	Secondary (slow pickup)		x	x	x
Switch overload (adjustable)		x			
Two-rate charge control (adjustable, temperature compensated)		x			
Light-out (rectifier for a-c. operation)		x			
Power-transfer (rectifier for a-c. operation)		x	x	x	
Retained-neutral neutral, line			x	x	x
Flasher			x		
Interlocking, line or track					x
Retained-neutral polarized, track (partial slow pickup and release)					x
Neutral-polarized, line or track (normal or slow release)				x	x
Retained-neutral polarized	Line			x	x
	Track				x
Motor-operated timer (adjustable; has check contact)		Special Size			
Code transmitting and code following		Special Size			

RAILWAY SIGNAL APPLIANCES

Dimensions and approximate weights are as follows:

Type K, Size	Approximate Weight (pounds)	Height	Width (in inches)	Depth
2	6	7-5/8	3-7/8	6-1/4
4	14	8-5/8	7-3/8	6-3/8
6	20	9-1/8	7-11/16	7-1/4
8	22	9-1/8	10-1/8	6-1/4



Figure 3. Type B relays are plugged in, or removed, without touching a wire.

RELAYS

TYPE B RELAYS

Type B relays represent the most modern development in signaling relays. They can be used in any railway signaling circuit designed for d-c. operation. The Type B neutral relay can be operated from a.c. through a rectifier. They are compact plug-in units occupying only a third of the space required by earlier designs of signaling relays. They have large contact capacity and are available with a wide range of operating characteristics and contact arrangements. Thus you gain maximum standardization of relays, you can reduce spare relay inventories, and you are assured of long relay life, simplified maintenance and inspection, and most efficient use of available space.

As shown in Figure 3, installing or removing a Type B relay is quick and simple — you don't touch a wire.

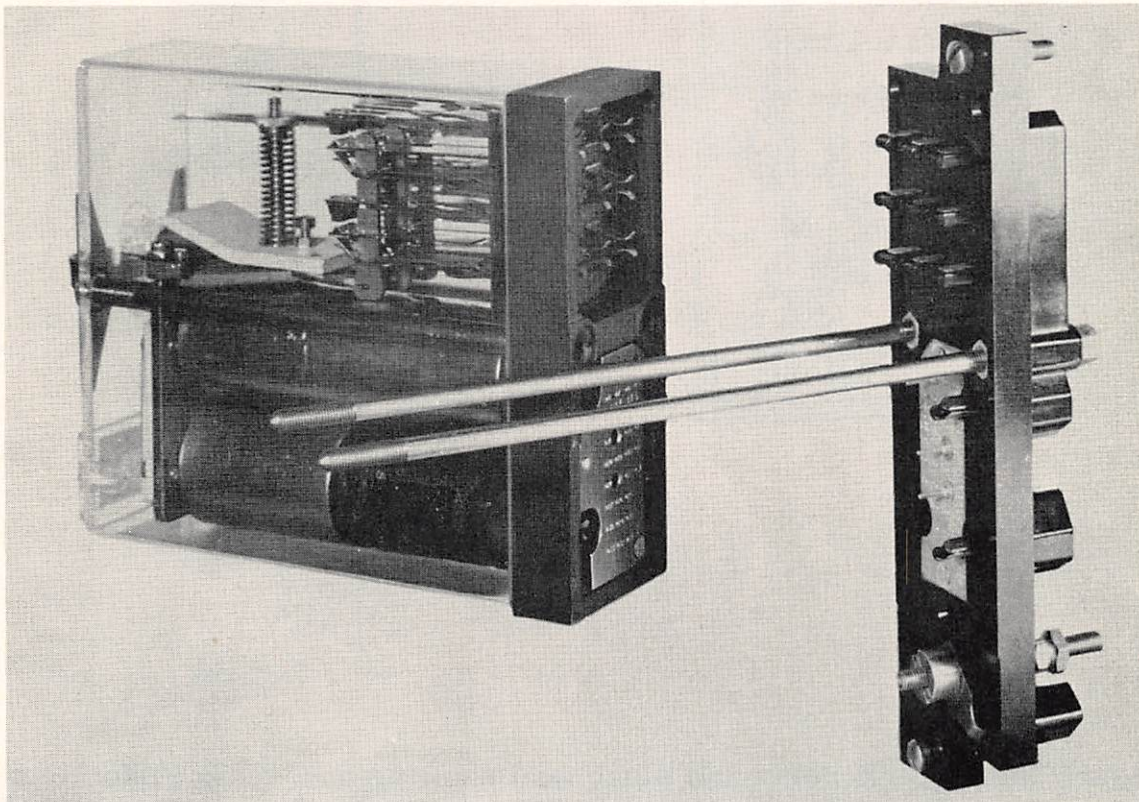


Figure 4. Type B, Size 1 (B1) relay and plugboard. Note female registration plate on relay and male registration plate on plugboard.

RAILWAY SIGNAL APPLIANCES

Sizes

Type B relays are made in two sizes, B1 (Figure 4) and B2. Each is $6\frac{5}{16}$ inches high and $8\frac{9}{16}$ inches deep. The B1 is $2\frac{7}{16}$ inches wide, and the B2 is $4\frac{15}{16}$ inches wide. Weights vary according to construction. B1 relays weigh from 7 to 10 pounds; B2, from 10 to 15 pounds. The B2 relay takes just twice as much plugboard space as the B1.

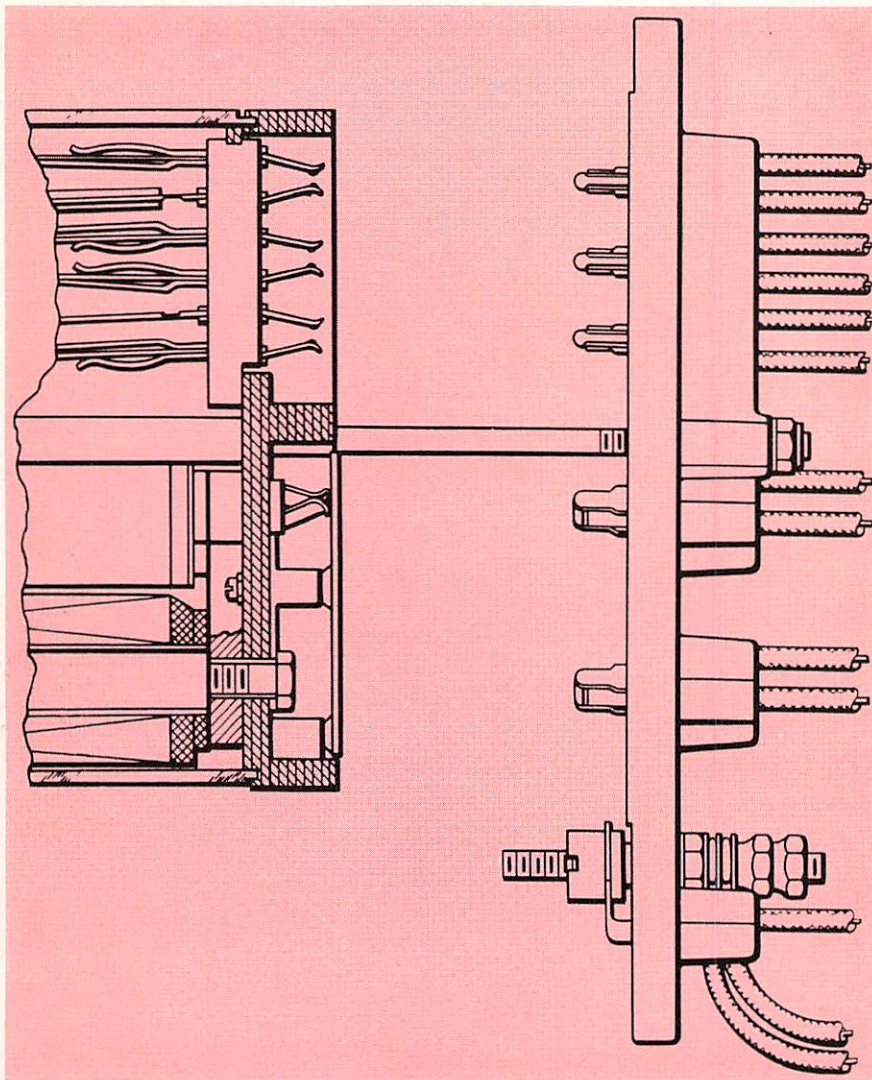


Figure 5a. Type B relay and plugboard showing how relay slides into place on studs projecting from the plugboard. All wiring is at back of plugboard.

RELAYS

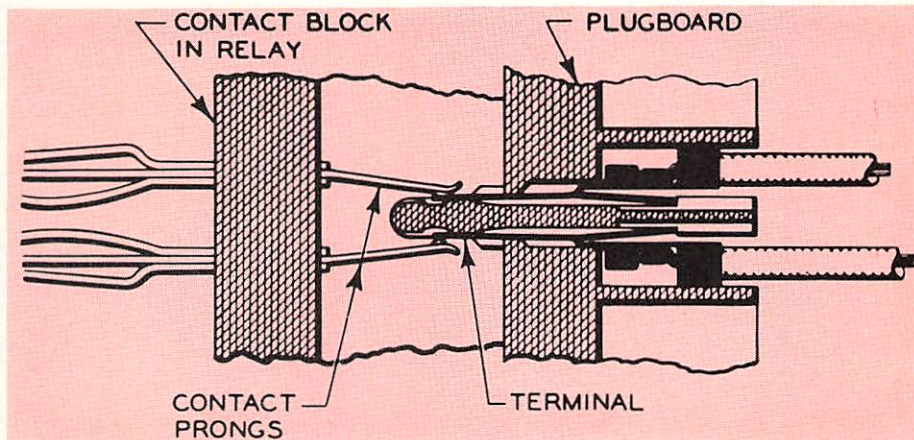


Figure 5b. Enlarged detail showing how connections are made when relay is plugged into place.

Contacts

Contacts are phosphor-bronze leaf springs molded in bakelite blocks. One end of the spring is formed into a prong which makes contact with the plugboard terminal, Figure 5b. The other end has a contact tip.

There are six springs per block. They are furnished in various combinations of contact groups. Thus you can have two dependent front-back contacts or three independent contacts (front or back) per block or combinations thereof.

The B1 relay has space for three contact blocks. The B2 relay has space for six contact blocks.

Front contacts are silver to silver-impregnated carbon; back contacts are silver to silver. Regular or heavy-duty contacts are available, choice depending on maximum current contacts are designed to handle. For opening heavy-current d-c. circuits, contacts are supplied with permanent magnet blowouts that immediately disrupt any arc that may form across the gap of an opening contact.

RAILWAY SIGNAL APPLIANCES

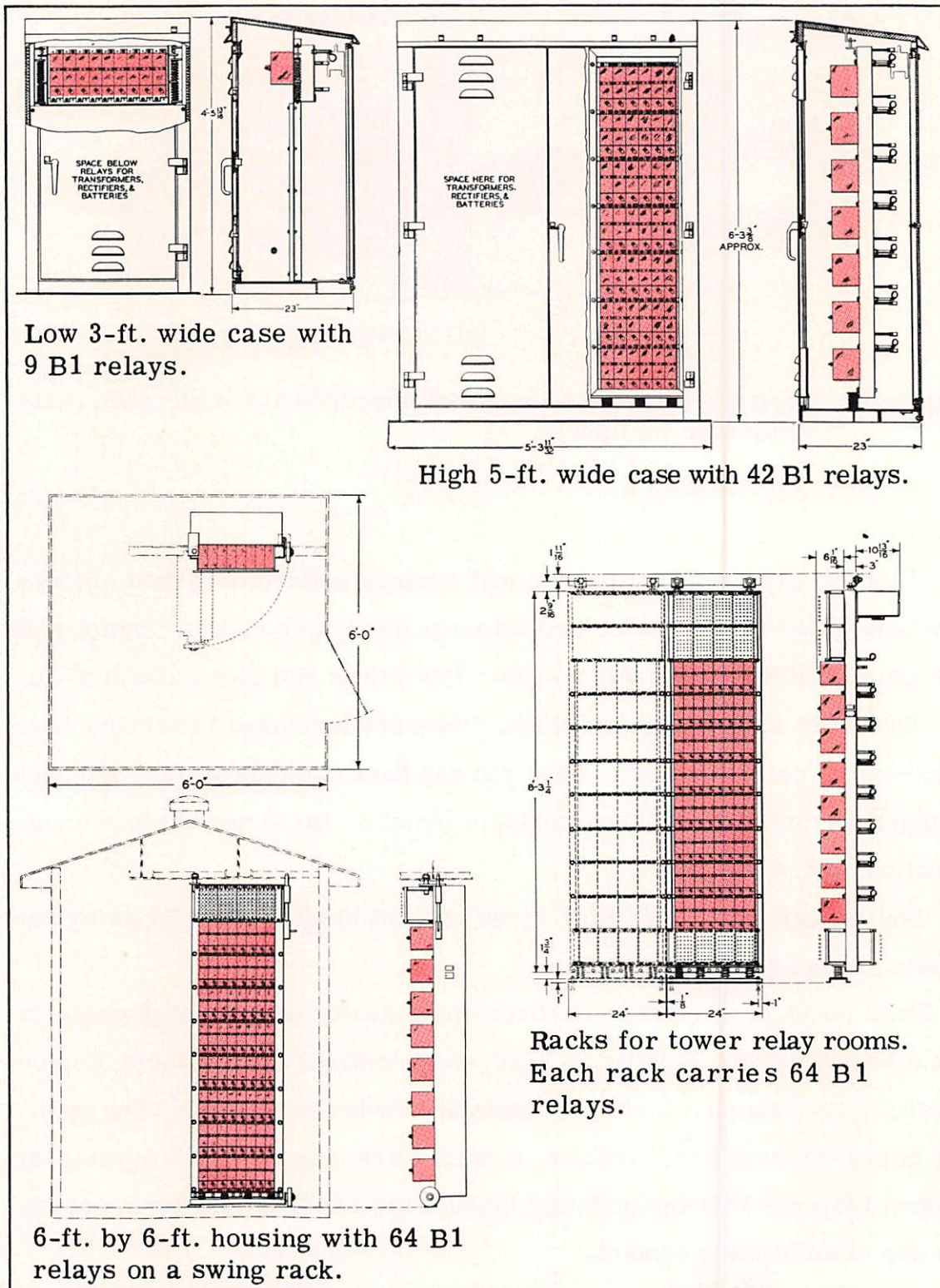


Figure 6. Here are some typical examples of the way Type B relay racks are mounted in cases, housings, and relay rooms.

RELAYS

Plugboards

Relay plugboards, such as shown in Figure 4, are bolted to mounting bars. The mounting bars are arranged in racks, Figure 6, in various sizes to fit the requirements of tower or instrument housing installation.

Each relay and its associated plugboard are equipped with matching registration plates to prevent plugging in a relay that does not have proper timing, contact arrangement or contact openings for the circuits associated with a given plugboard. Registration also differentiates between track and line relays.

Easily accessible terminals make it easy to read current or voltage without unplugging a relay or going behind the plugboards.

Types

Besides neutral relays with normal or special operating times, Type B relays are also supplied with polarized structures. When desired, neutral or polarized structures can be furnished to keep neutral contacts closed during normal pole changing time. Specialized Type B relays include motor-operated flashing relays for highway crossing circuits, motor-operated time-element relays, relays especially designed for coded track circuits, and many other special types particularly developed for the varied and exacting requirements of signaling practice as shown in the following table. The difference between line and track relays is their coil resistance, track relays having very low resistance to operate on low voltage.

RAILWAY SIGNAL APPLIANCES

USE AND DESCRIPTION		Available Sizes	
		B1	B2
Neutral, track		x	
Neutral, line (slow release, slow pickup, or slow pickup and release)		x	
Biased-neutral, line		x	
Magnetic-stick, line		x	
Neutral-polarized, line			x
Retained-neutral polarized, line			x
Retained-neutral neutral, line		x	
Primary-secondary, track	Primary	x	
	Secondary (slow pickup)	x	
Thermal timer (a-c. or d-c.)		x	
Motor-operated timer (adjustable; has check contact)			x
Motor-operated flasher			x
Two-rate charge control (adjustable; temperature compensated)		x	
Power-transfer (rectifier for a-c. operation)		x	
Light-out (rectifier for a-c. operation)		x	
Approach-lighting		x	
Switch-overload (adjustable)		x	
Code-following		x	
Code-transmitting			x
A-c. vane, track			x

RELAYS FOR COMMUNICATION CIRCUITS

Type A1 neutral and magnetic-stick, Type V2 polar, and Type VX polar relays are compact plug-in relays. They are used primarily for communication circuits in centralized traffic control, relay interlocking, and

RELAYS

automatic switching systems.* They mount on plugboards which are attached to mounting bars in cabinets of various sizes. These cabinets are located in towers and wayside housings where they are anchored on shelves or bolted in B relay racks, Figure 7. The relays are also housed in sliding cabinets built into control machines, Figure 8.

Type A1 Relay

Type A1 relays are very similar in construction to Type B relays but are smaller, measuring 2 inches wide, 4-1/2 inches high and 5-1/2 inches deep. Weight is approximately 2 pounds.

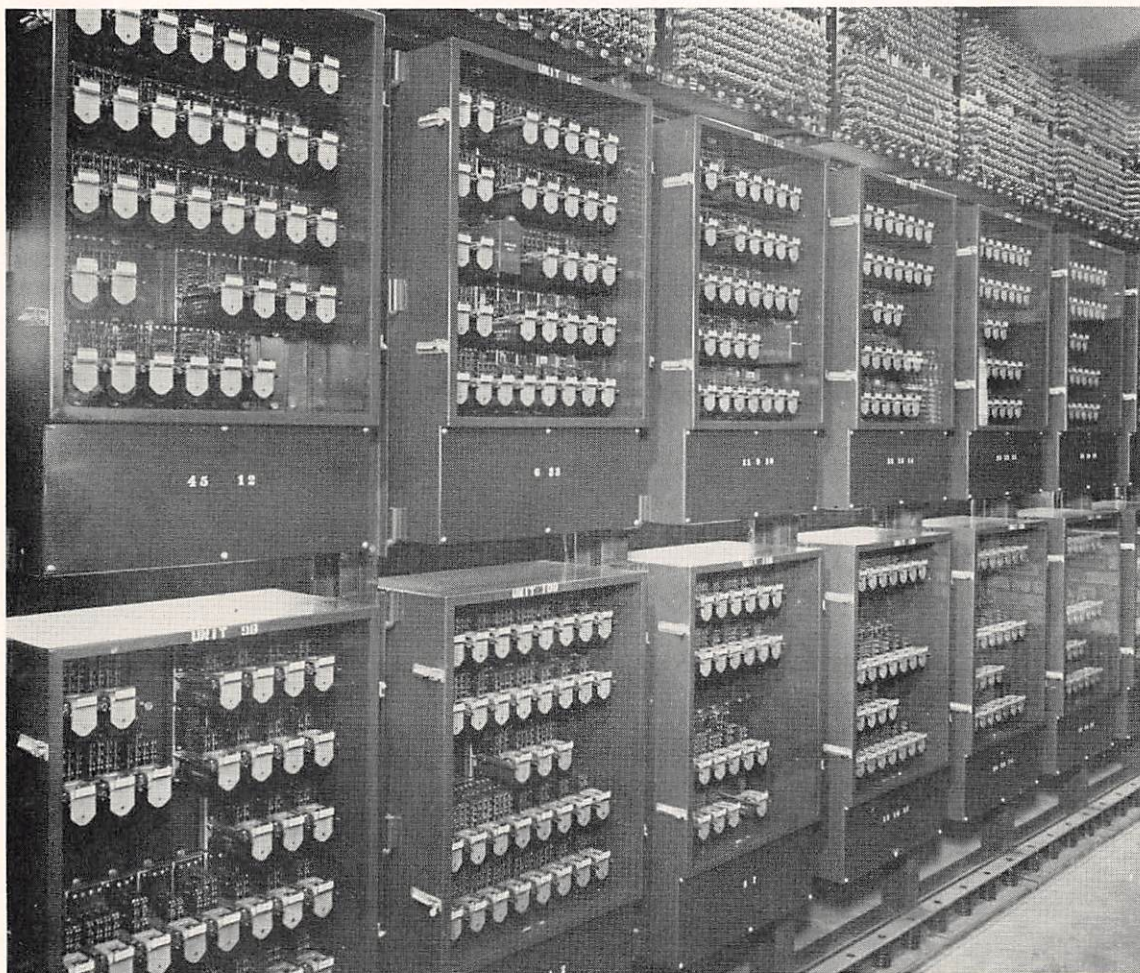


Figure 7. Communication relays mounted in cabinets bolted to Type B relay racks.

* For a description of these systems, ask for Pamphlet 750.

RAILWAY SIGNAL APPLIANCES

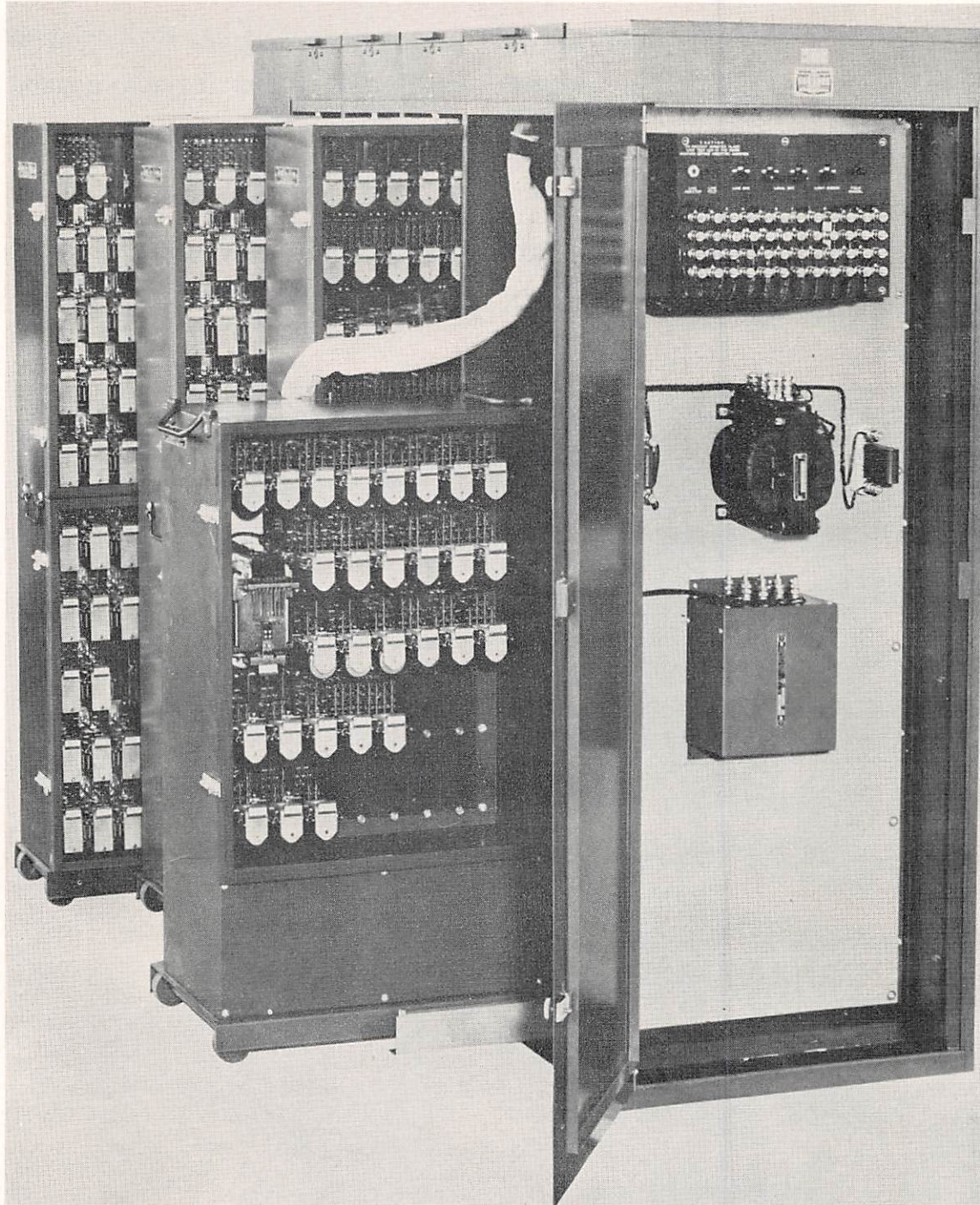


Figure 8. Communication relays housed in sliding cabinets built into control machine.

RELAYS

Type A1 relays are usually furnished for operation on 24 volts d-c., but are available for operation on other voltages. They are classed as neutral or magnetic-stick relays. Neutral relays, by the addition of a slug on the core, can be made slow pickup and release. The relay structure has an L-shaped armature which operates the contacts through in-

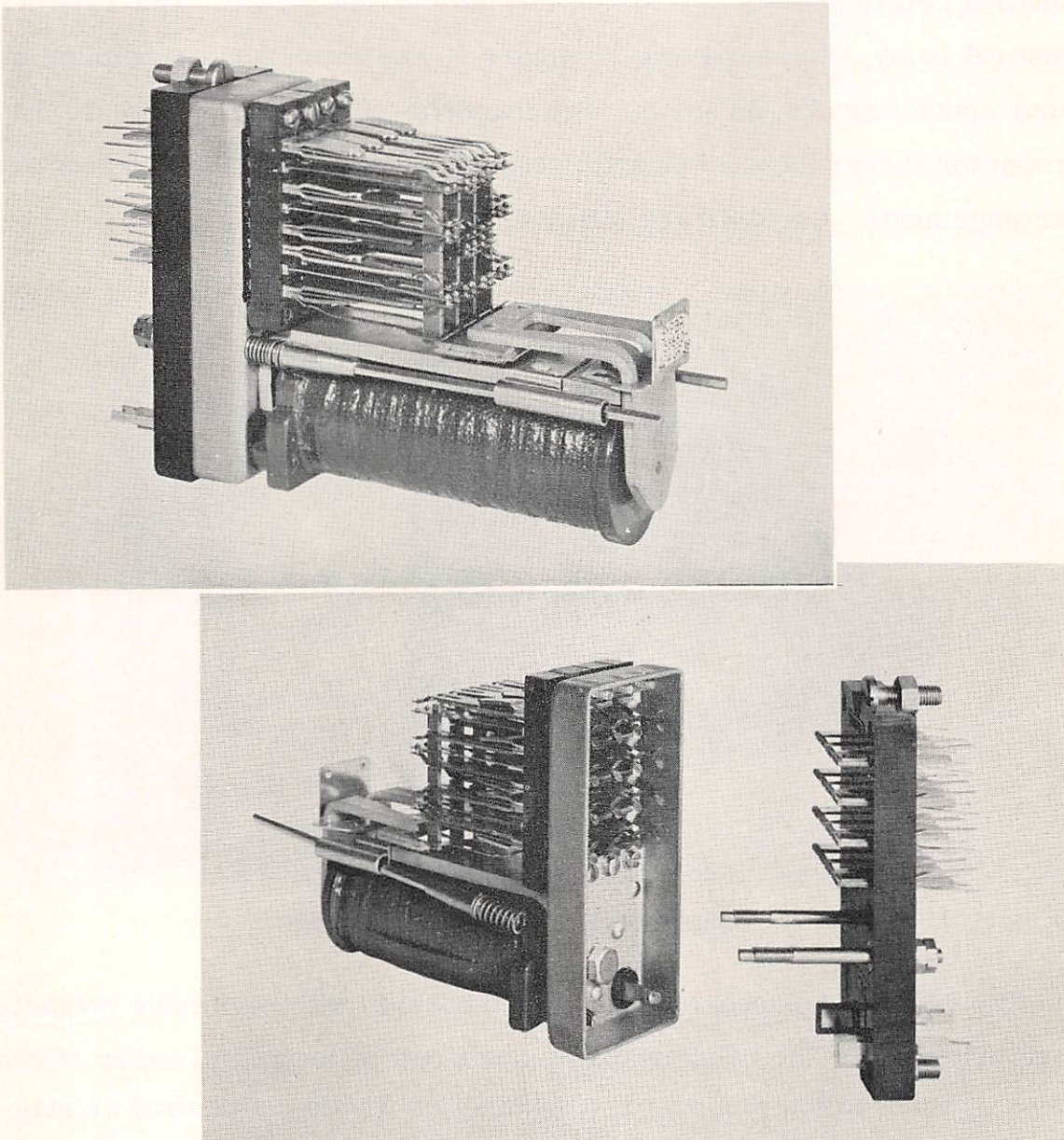


Figure 9. Type A1 neutral relay and plugboard. Bottom view shows relay unplugged.

RAILWAY SIGNAL APPLIANCES

sulated pushers. As can be seen in Figure 10, the front contacts, fingers, back contacts, and coil connections are shaped on the back of the relay in the form of jack connections. These engage with the plug terminals on the plugboard. Bifurcated contact springs and stops are molded into bakelite contact blocks with a maximum of eight springs per block on neutral relays and six springs on magnetic-stick relays. The Type A1 neutral relay, such as shown in Figure 9, has room for a maximum of four contact blocks, as shown. The magnetic-stick relay, Figure 10, has room for three blocks. Contact blocks are available with various contact arrangements. Contacts are silver to silver.

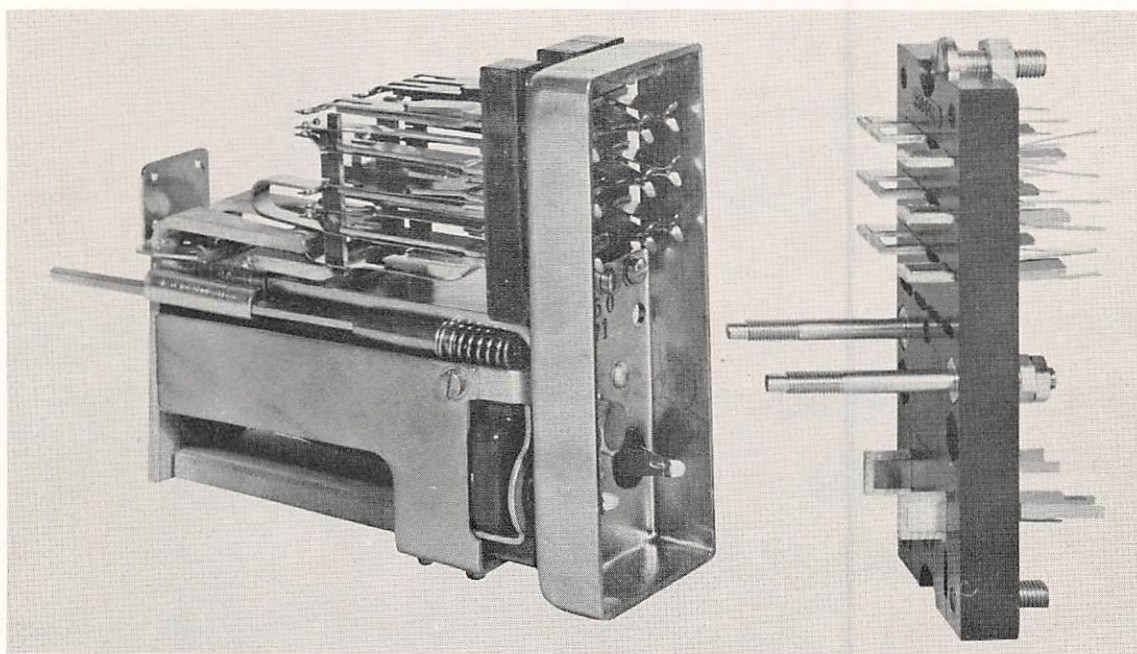


Figure 10. Type A1 magnetic-stick relay unplugged.

Type A1 relay plugboards are molded bakelite with removable contacts and insulators. The relay mounting studs can be located in either of two sets of holes in the plugboard, depending on whether a neutral or magnetic-stick relay is to be installed.

RELAYS

Type V2 Polar Relay

The Type V2 polar relay, Figure 11, is a plug-in type occupying plug-board space equivalent to four Type A1 relays, two wide and two high. It is 4 inches wide, 9 inches high and 5-1/2 inches deep. Weight is approximately 7-1/4 pounds. It operates in series or multiple with d-c. line circuits of varying voltage. Two normal and two reverse contacts are available on this relay.

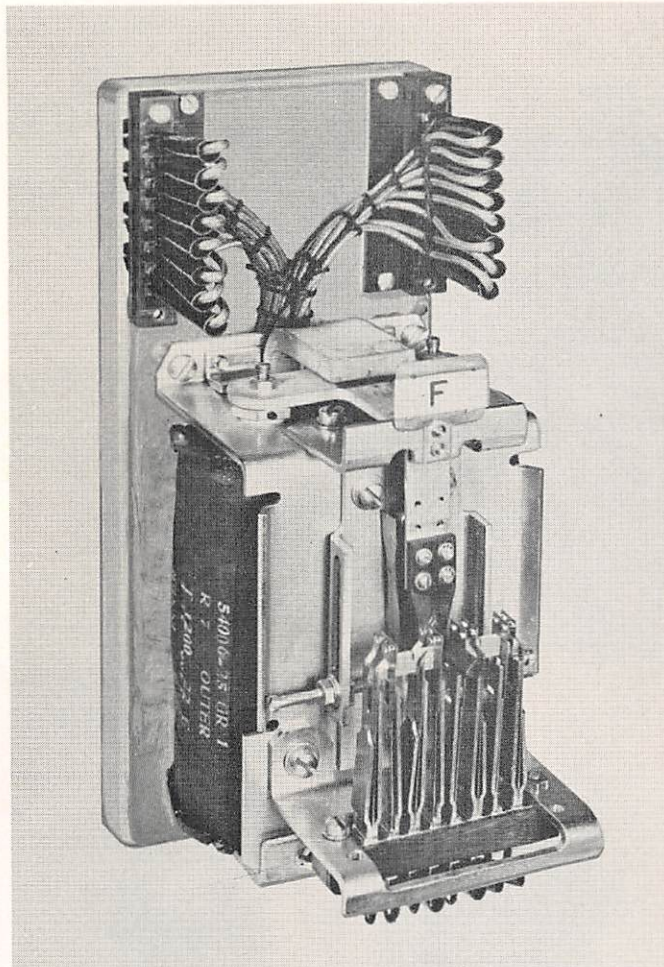


Figure 11. Type V2 polar relay.

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Type VX Polar Relay

The Type VX relay, Figure 12, is a fast-acting relay with a maximum of four dependent normal-reverse contacts. It is available as either a biased-neutral relay or a two-position polar relay whose polar contacts remain in the last operated position when energy is cut off the relay.

The Type VX relay takes space equivalent to three Type A plugboards. It is 6 inches wide, 4-1/2 inches high, and 3 inches deep. Weight is approximately 2 pounds 2 ounces. This relay is also available for shelf mounting.

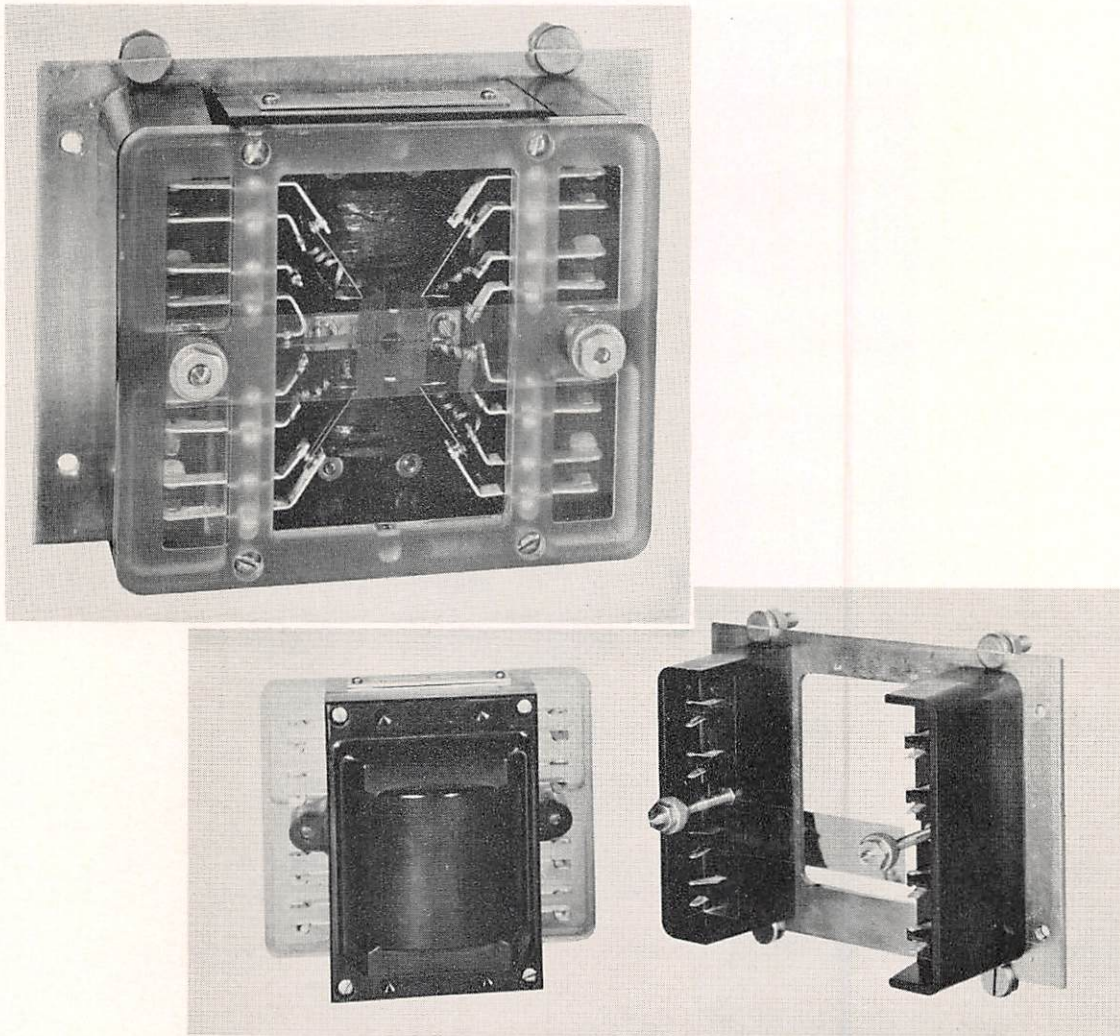


Figure 12. Type VX polar-biased relay. Bottom view shows relay unplugged.

RELAYS

ALTERNATING CURRENT RELAYS

G-R-S manufactures a complete line of a-c. relays for track and line use. While relays can be arranged for special voltages and frequencies, standard local windings are for 110 or 55 volts, 50 or 60 cycles; or for 57 or 27.5 volts, 25 cycles. When you order track relays, G-R-S representatives should be consulted so that we can furnish you with the most efficient track relay for your requirements.

All relays are furnished with glass covers to facilitate contact inspection. Contacts are silver to silver-impregnated carbon. Coil and terminal leads are brought out to standard A.A.R. no. 14-24 binding posts. Mountings are for shelf or wall use, with vibration-absorbing springs as required.

Model 2, Form A Relay

The Model 2A relay, Figure 13, is primarily designed as a highly efficient double-element track relay for steam roads or for d-c. propulsion roads. It will operate on track circuits as long as 7000 feet. The single-element 2A relay for a-c. traction roads can be used on track circuits up to about 1000 feet long. The Model 2A relay is also available for use as a line relay.

Principle of operation is similar to that of a small induction motor. The aluminum rotor is cup-shaped. It is mounted so as to revolve in the air gap between the stator and the core. The stator is of slotted laminated construction with distributed windings. Each winding group, local and track (or line), is brought to binding posts so that it may be connected in multiple or in series. This makes it convenient to connect

*See also Type B plug-in a-c. vane relay, p. 20.

RAILWAY SIGNAL APPLIANCES

a balancing impedance to the midpoint of the track winding, if used on single-rail track circuits with d-c. propulsion.

The Model 2A is available in two sizes, 4-way and 6-way; and in two types, 2-position and 3-position. Maximum contact capacity of 4-way is 8 independent front (or back) contacts or the equivalent in various other arrangements. Maximum contact capacity of 6-way is 12 independent front (or back) contacts or the equivalent in various other arrangements.

Operating time to open front contacts is 0.32 second for regular and 0.15 second for the quick-acting track relay.

The Model 2A, 4-way relay measures 8-7/8 inches high, 8-3/4 inches wide, and 11-7/8 inches deep. Weight is about 45 pounds. The 6-way size measures same height and depth but is 11-1/4 inches wide and weighs about 50 pounds.

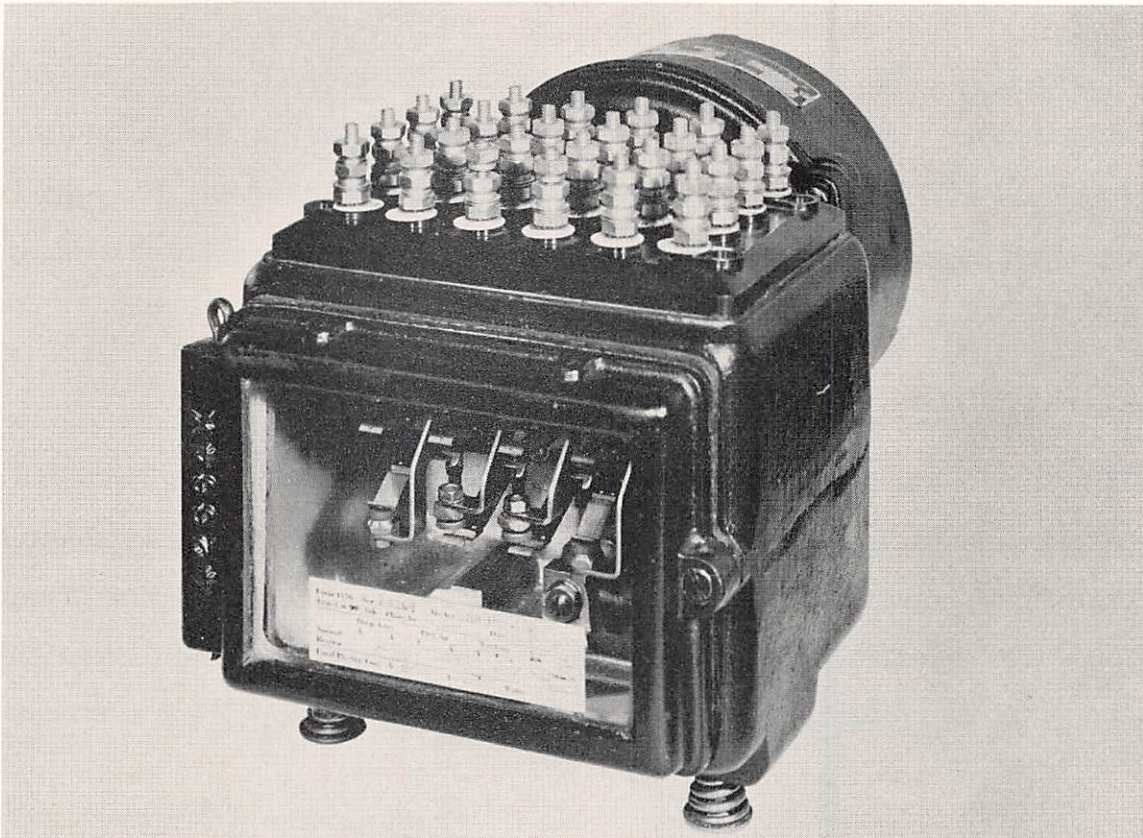


Figure 13. Model 2, Form A, 2-position, double-element, a-c. relay.

RELAYS

Type L Vane Relay

The Type L vane relay, Figure 14, is designed primarily for use as a line relay, but it may be used as a track relay on short track circuits on steam roads. It is furnished as either a single- or double-element, 2-position relay.

Maximum contact capacity is 2 dependent front-back contacts, 4 independent front contacts, and 2 independent back contacts.

The entire relay structure is clearly visible through the cylindrical glass cover. Coils can be changed without unstacking laminations. Vane is specially treated to eliminate warping, and vane shaft turns in jeweled bearings.

The Type L is 9-7/8 inches high and 8-1/8 inches in diameter. It weighs about 14 1/2 pounds.



Figure 14. Type L, 2-position, single-element, a-c. vane relay.

RAILWAY SIGNAL APPLIANCES

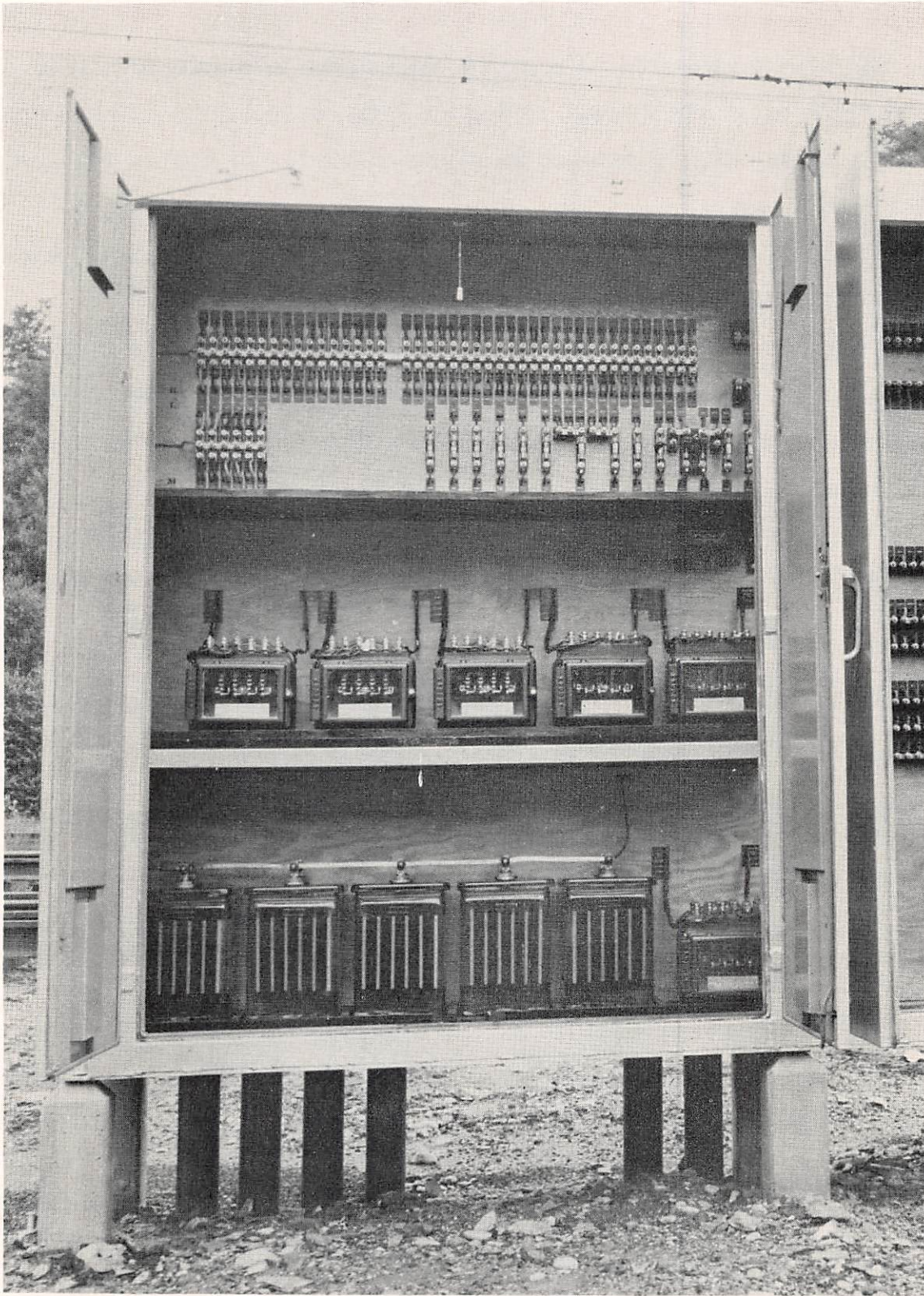


Figure 15. Model 2A a-c. relays in wayside case.

RELAYS

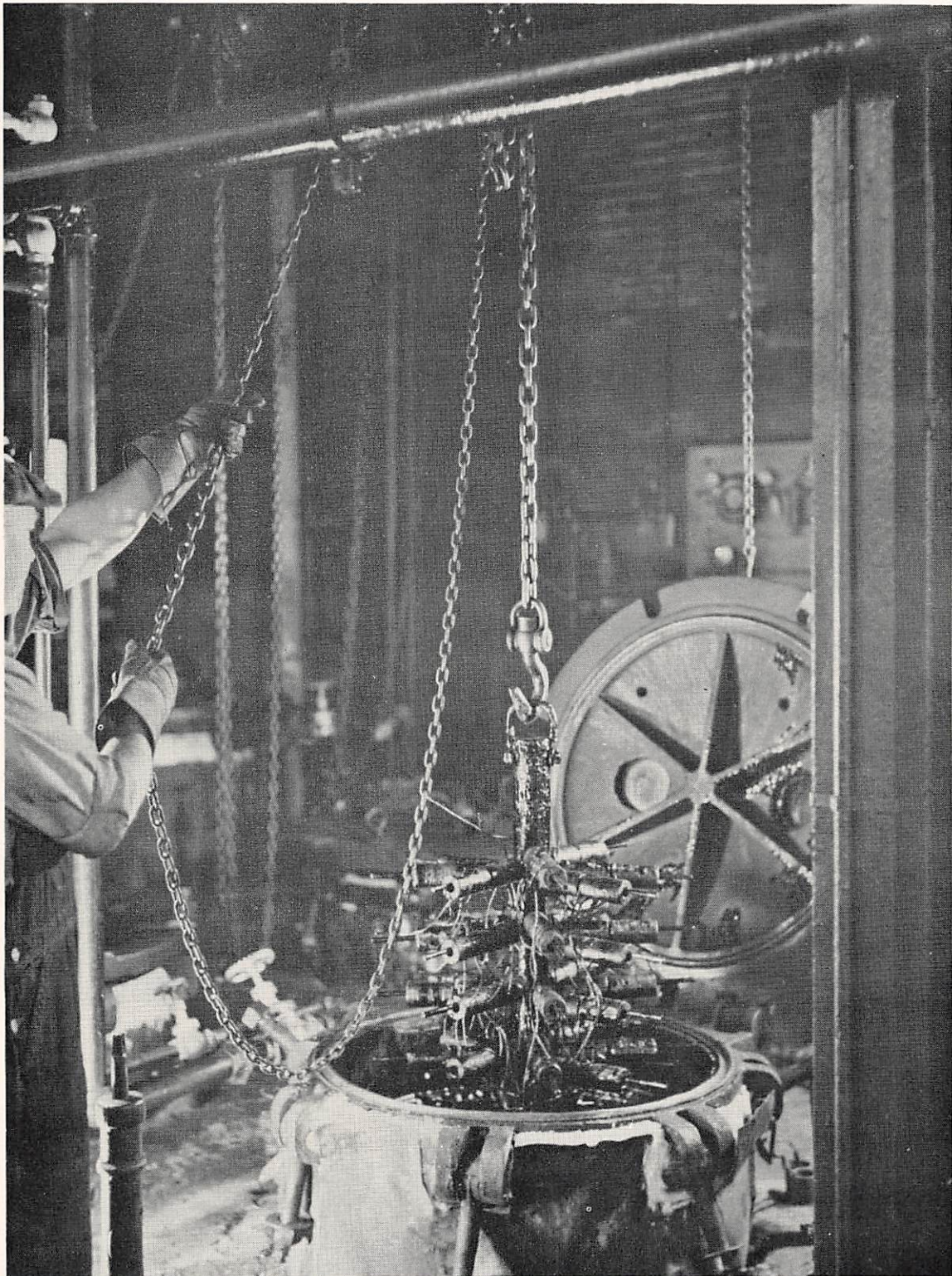
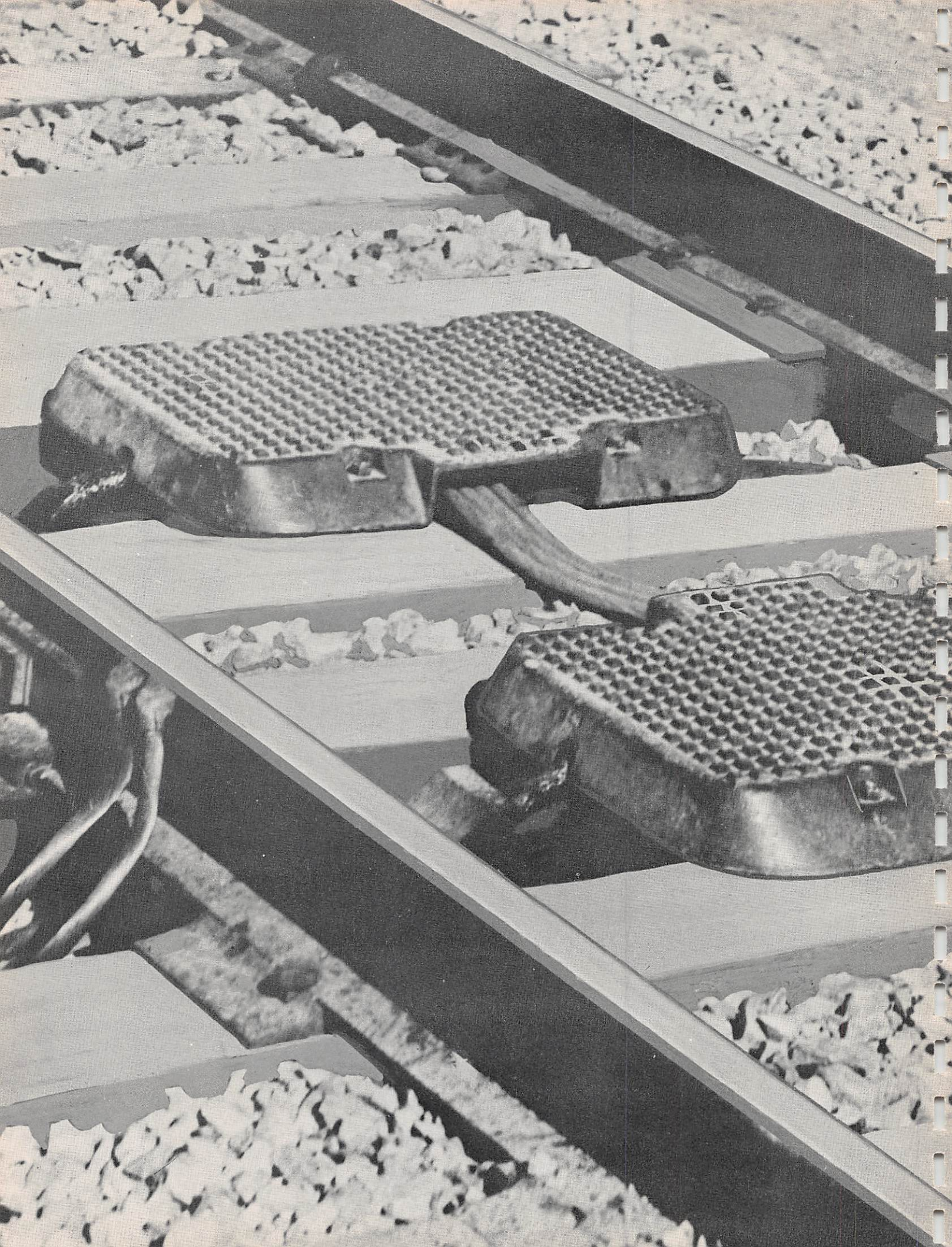


Figure 16. Impregnation in vacuum tanks protects relay coils from moisture.



REACTOR (IMPEDANCE) BONDS

RAILWAY SIGNAL APPLIANCES

REACTOR (IMPEDANCE) BONDS

When automatic block signals with track circuit control are installed on electric traction lines where both rails are required for the return propulsion current, it is necessary to install reactor bonds (also known as impedance bonds) at the signal locations. Such bonds are shown in Figures 17 and 18.

The track is divided into sections of varying length by means of insulated rail joints, which are located as near as possible to the signals. The function of the reactor bond is to make the rails electrically continuous for the return propulsion current and at the same time electrically insulated for the a-c. track circuit current.

The size of the bond depends on the amount of propulsion current it will have to carry, the impedance it must provide, and the amount of unbalancing likely to occur. Bonds are ordinarily designed for 20 percent unbalancing; that is, the current in one rail may exceed the current in the other rail by an amount equal to 20 percent of the sum of the two currents,

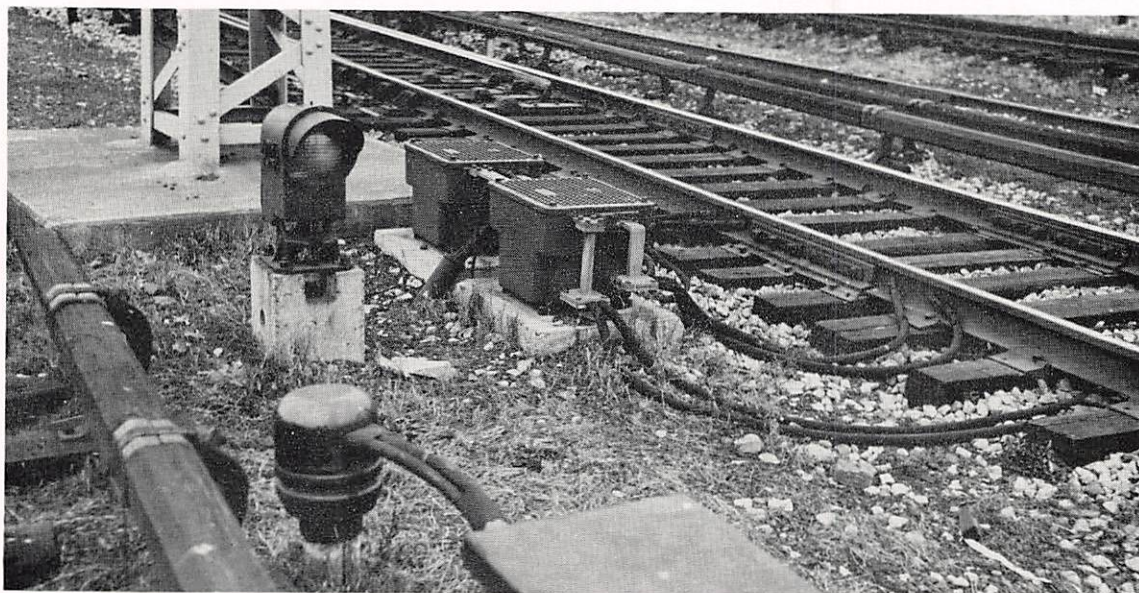


Figure 17. Impedance bonds installed on electrified zone of New York Central System.

REACTOR BONDS

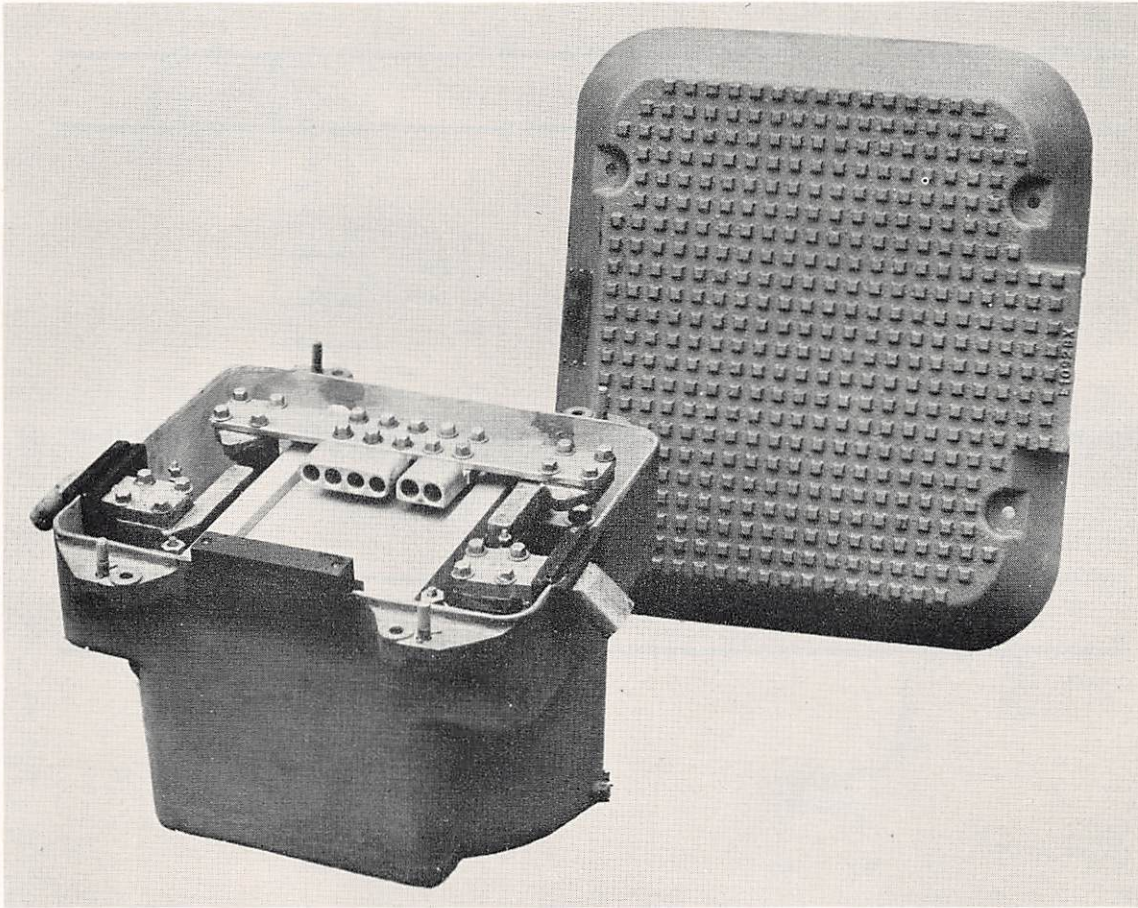


Figure 18. Reactor bond with cover removed.

without seriously affecting the impedance of the bond.

G-R-S bonds are of such dimensions as to permit their being installed between the rails. Their sloping covers lessen the danger from dragging equipment. Leads are brought out of the case to facilitate connection to rails. Petrolatum furnished with the bonds is solid at ordinary temperatures and cannot be discharged should water enter.

When bonds are ordered, specify whether propulsion is a-c. or d-c., frequency of signaling current, normal and maximum current in amperes per rail, duration of maximum current, percent of unbalanced current, and impedance desired.

G-R-S bonds are built in sizes to handle up to 1500 amperes d.c. per

RAILWAY SIGNAL APPLIANCES

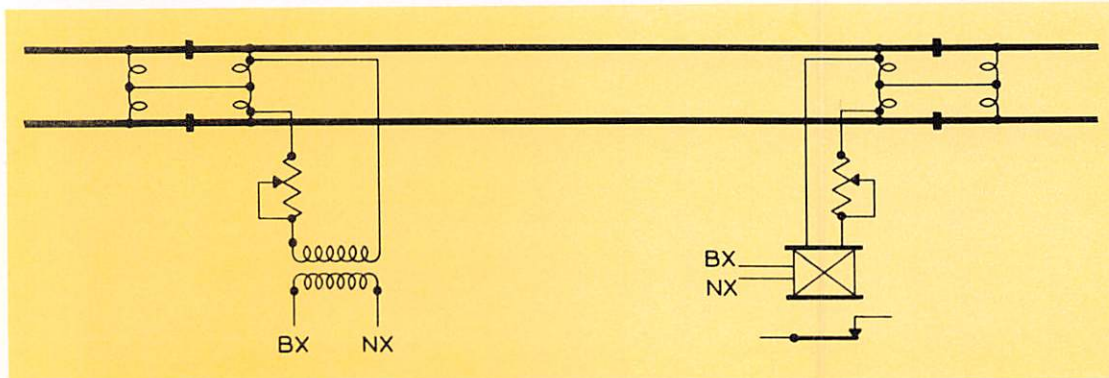


Figure 19. Simplified circuit showing reactor bonds for use with d-c. or a-c. propulsion.

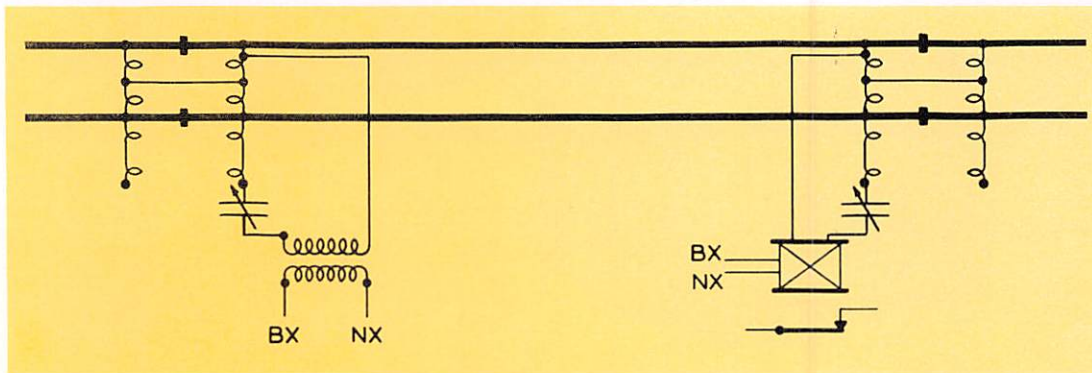


Figure 20. Simplified circuit showing use of reactor bonds with auto winding and capacitor for use with d-c. propulsion.

rail continuously, offering approximately 0.5 ohm impedance per volt at 60 cycles; and up to 300 amperes a.c. per rail continuously, offering 2.5 ohms impedance per volt at 60 cycles.

Dimensions and weights vary with type and current ratings of bonds: height 10-1/4 to 14-1/2 inches, width 17-3/4 to 30 inches, depth 19 to 24-1/2 inches. Weights range from 280 to 750 pounds.

Figures 19 and 20 show, in simplified form, the place of the reactor bonds in the track circuits.

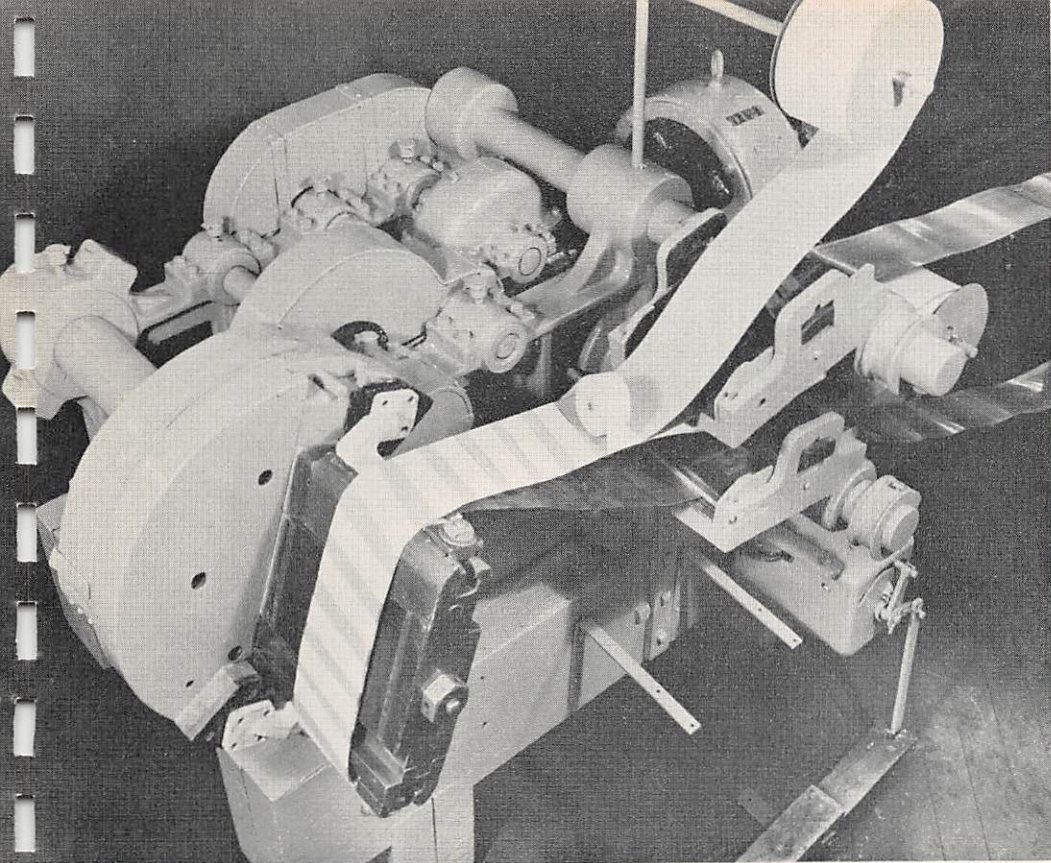


Figure 21. Machine winding impedance bonds.

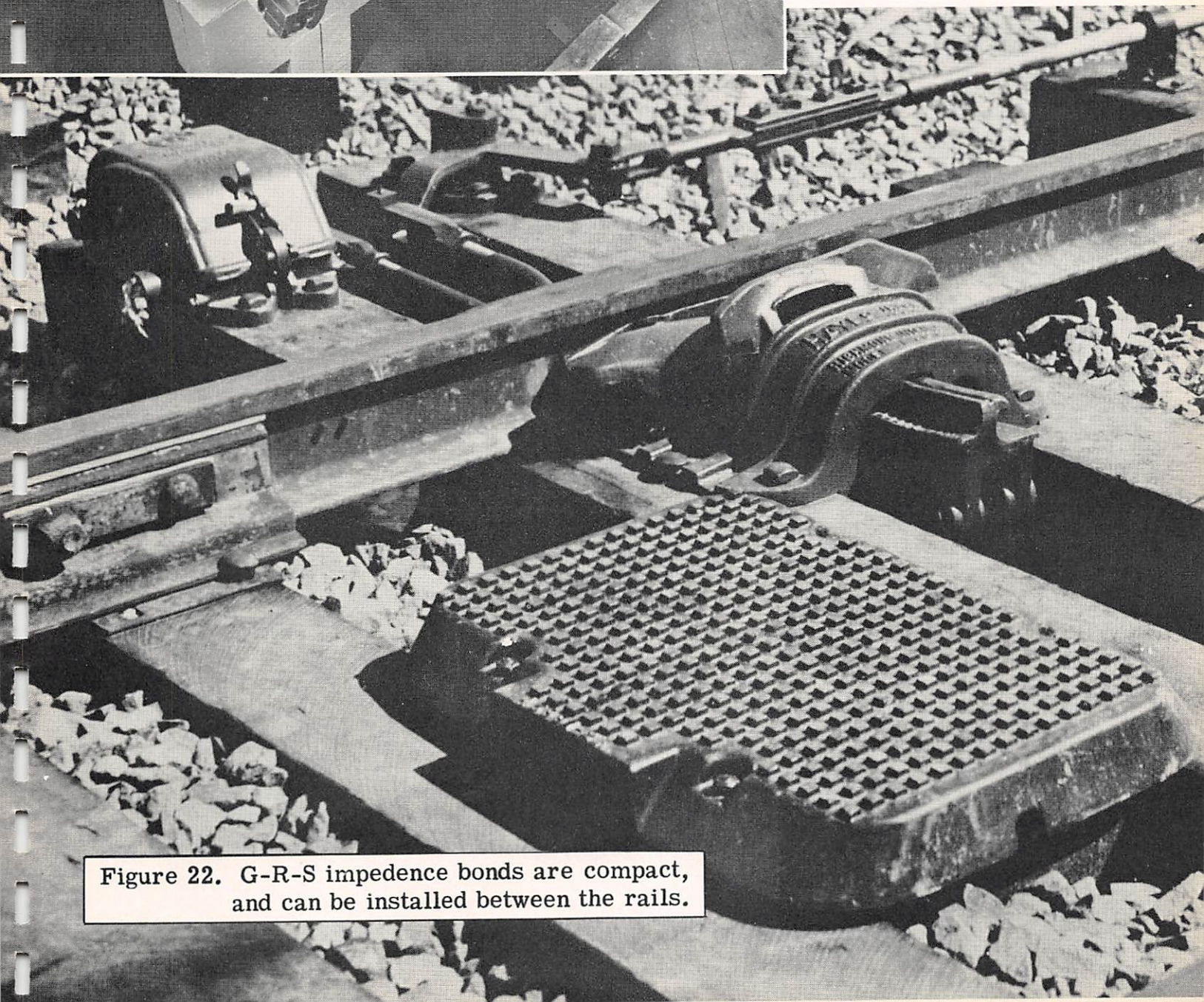
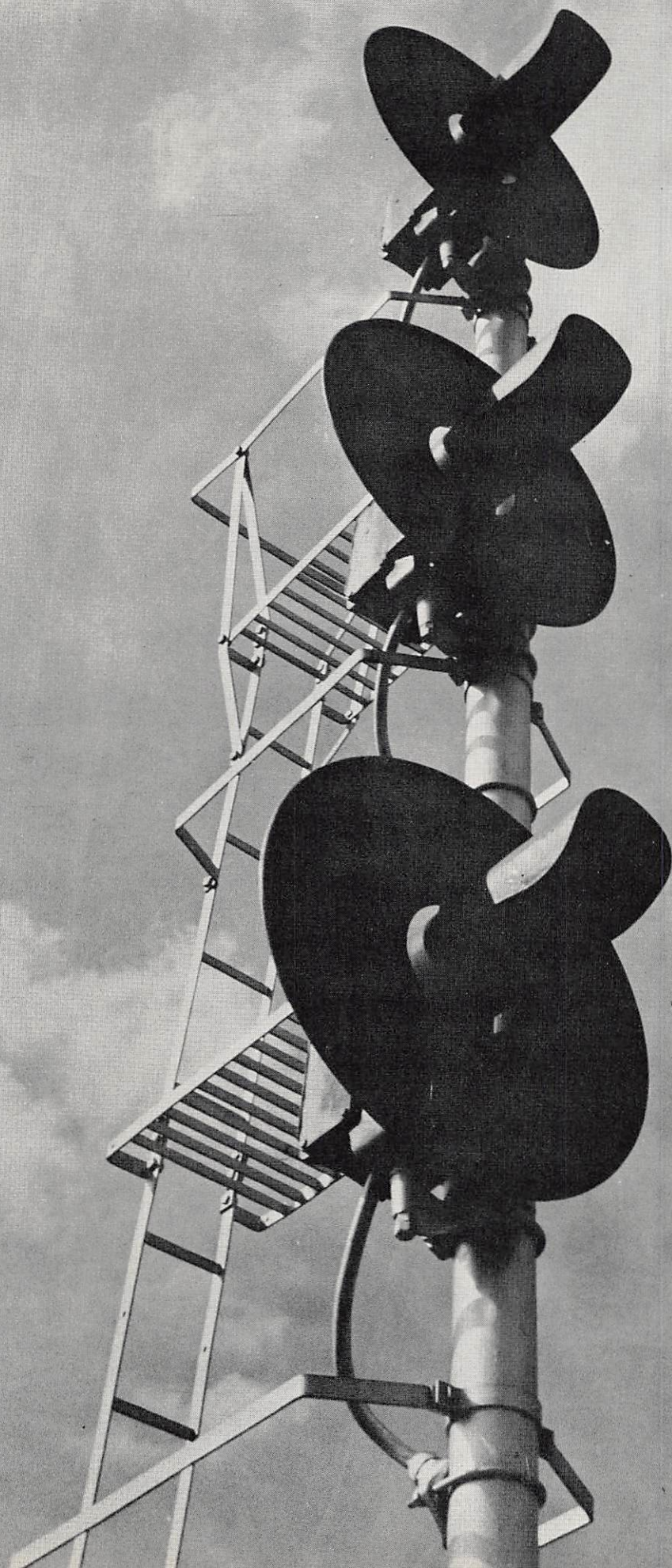


Figure 22. G-R-S impedance bonds are compact, and can be installed between the rails.



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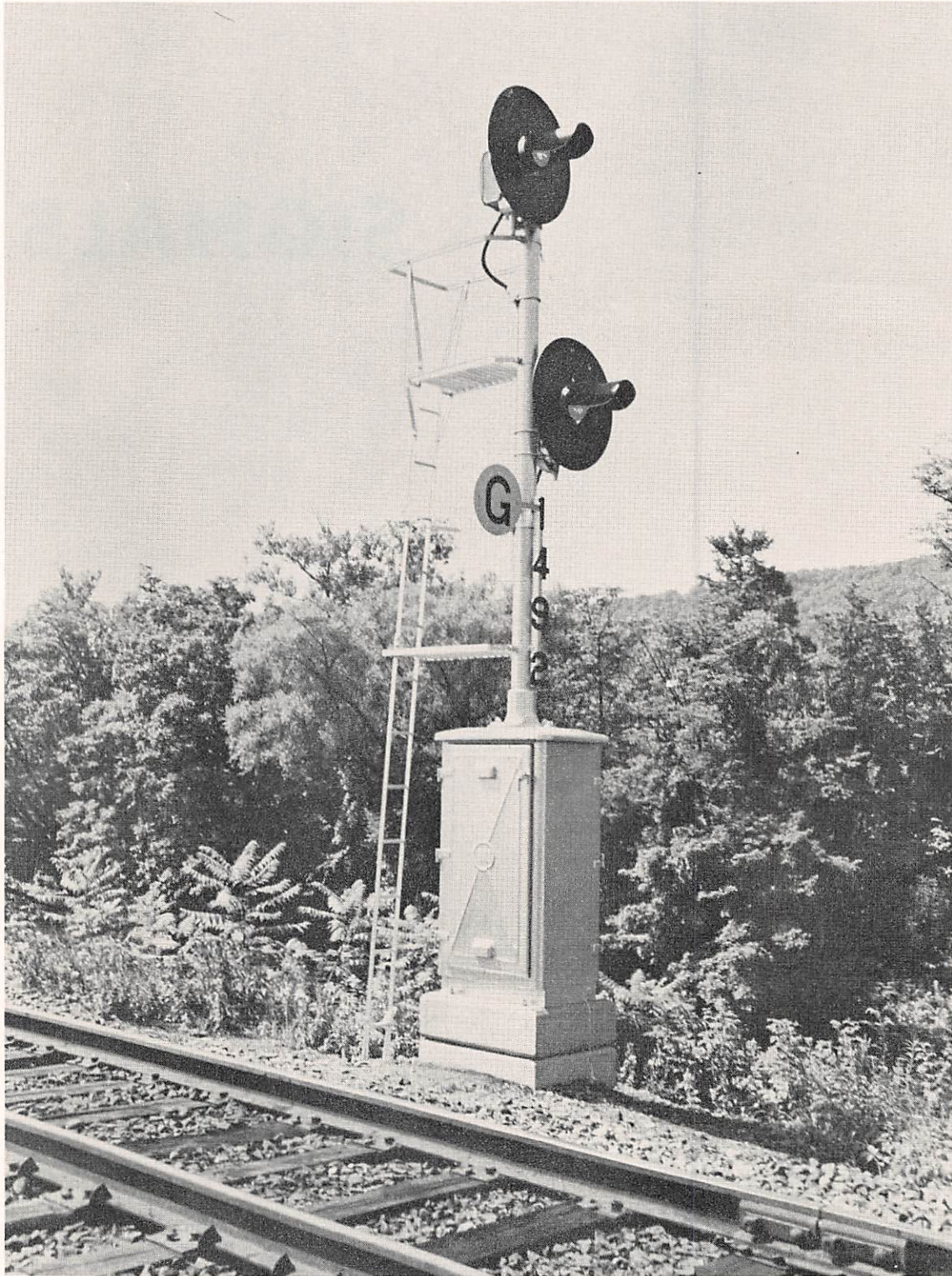


Figure 23. Two-arm Type SA searchlight signal mounted on welded steel instrument case.

SIGNALS

TYPE SA SEARCHLIGHT SIGNAL

The Type SA signal has a cast iron housing with a removable mechanism. The housing has a lens, hood, and adjustable mounting bracket. A background and a sighting device for aiming the beam are included on high signals, Figure 23.

The mechanism, an interchangeable unit, Figures 24 and 25, has a three-position relay which moves a spectacle with three color discs. The polarity of the control current determines whether a yellow or a green color disc is positioned at the focal point of the optical system. When the mechanism is not energized, a red color disc is positioned at the focal point by gravity.

Two optical systems are available, stepped lens, Figure 24, and compound lens, Figure 25. All outer lenses are 8-3/8 inches diameter. The

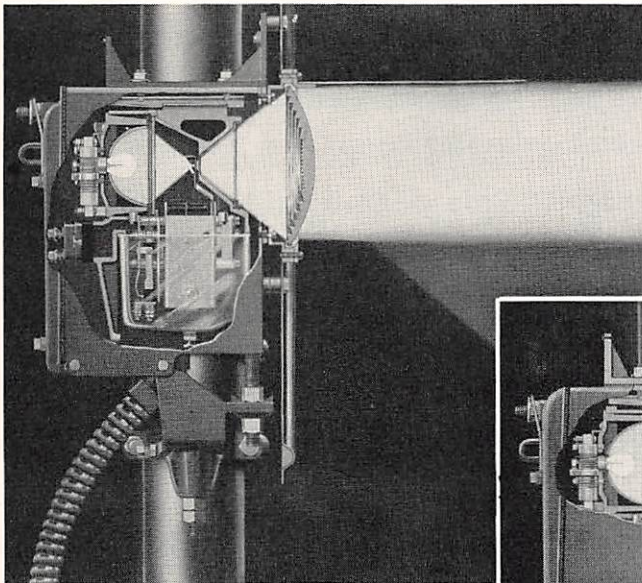


Figure 24. Type SA signal, cut away to show stepped lens systems.

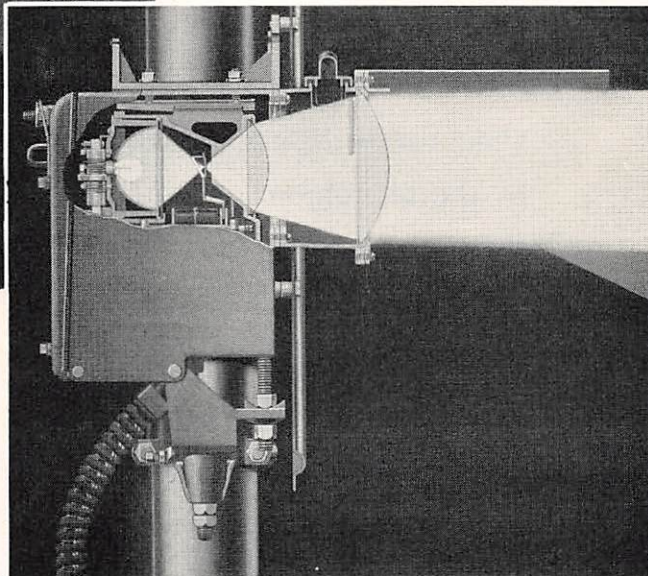


Figure 25. Type SA signal, cut away to show compound lens system.

RAILWAY SIGNAL APPLIANCES

compound lens, more efficient than the stepped, has a one-mile range with a 5-watt lamp - economical for primary battery operation.

With background, signal diameter is 35 inches. Depth is 30-1/2 inches with stepped lens, 34-1/2 inches with compound lens. Multiple-head signals with backgrounds are usually spaced 5 feet between lens centers. Thirty-six inch centers are minimum - not recommended where multiple aspects must be distinguished at great distances. Stepped-lens head complete weighs 140 pounds; compound-lens, 160 pounds.

Features

1. Showing three aspects from a single lens keeps beam at engine-man's level - all aspects in same position.
2. Same housing and operating mechanism used for high and dwarf signals, thereby reducing spare parts stock.
3. Alignment is made by hair-line sight. Adjustment in the horizontal and vertical planes is simple and easy.
4. Signal operating mechanism is easily and quickly replaced.
5. No focusing required when replacing lamps.
6. The signal is light in weight. This permits lighter construction in bridge or other supports.
7. It is compact in design, can be used where clearances are limited.
8. The position of the signal spectacle, carrying the miniature colored glass discs, is indicated by its contacts which are actuated directly by the movement of the operating shaft.
 - (a) Control of proceed aspect is broken through contact on signal mechanism instead of through a separate relay.
9. It gives a powerful long-range aspect with low energy consumption.
10. Reliability equal to that of modern relays.
11. Any reflected aspect that might be produced by external light would be the true aspect of the signal.

SIGNALS

12. Signal operates on the closed-circuit principle.
13. Red or stop aspect is secured by gravity to produce a stop aspect whenever energy is removed from the control, and since the same lamp is employed for three aspects a continual check is obtained on the ability of the signal to give its most restrictive aspect - a feature unique to searchlight signals.
14. You have only one lamp and lens to care for.
15. Its knife-edge bearings are absolutely free from the effects of vibration and operate in service indefinitely without any signs of wear or deterioration.
16. The light beam can be spread; see Figure 26.
17. SA signals are available in every type: top-of-mast, side-of-mast, one- and two-arm dwarf signals, and bridge signals.

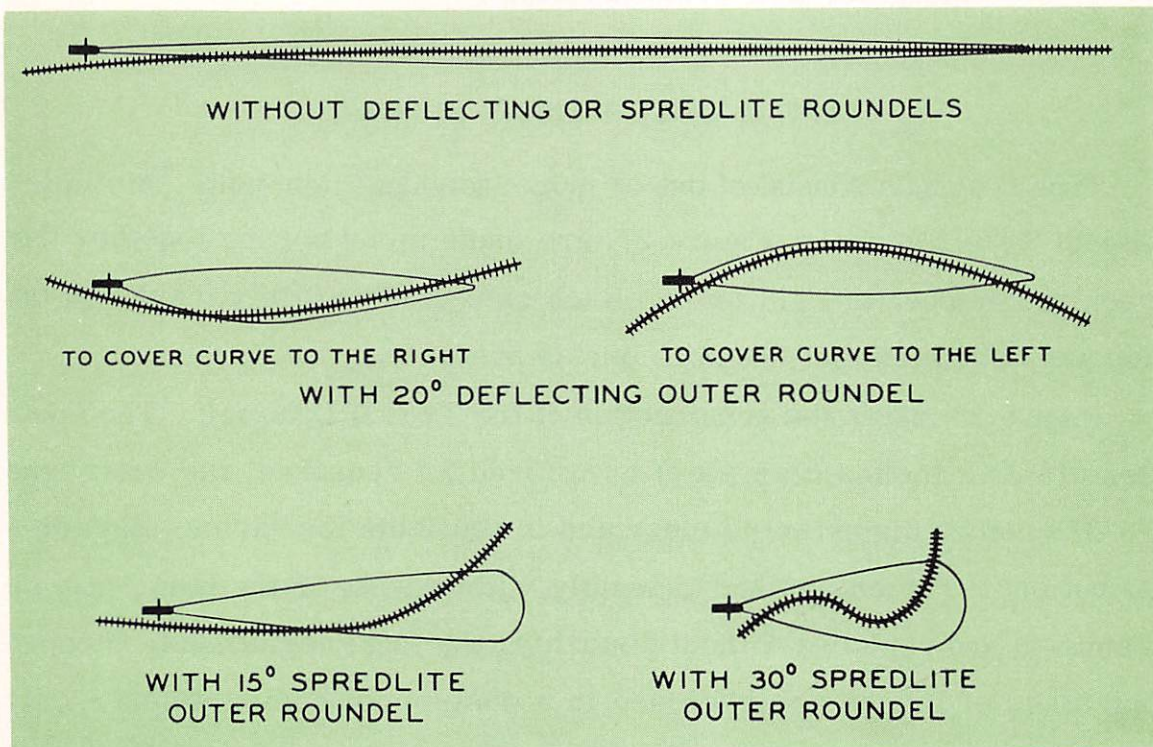


Figure 26. Various roundels are available for deflecting or spreading the light beam to fit geographic conditions.

RAILWAY SIGNAL APPLIANCES

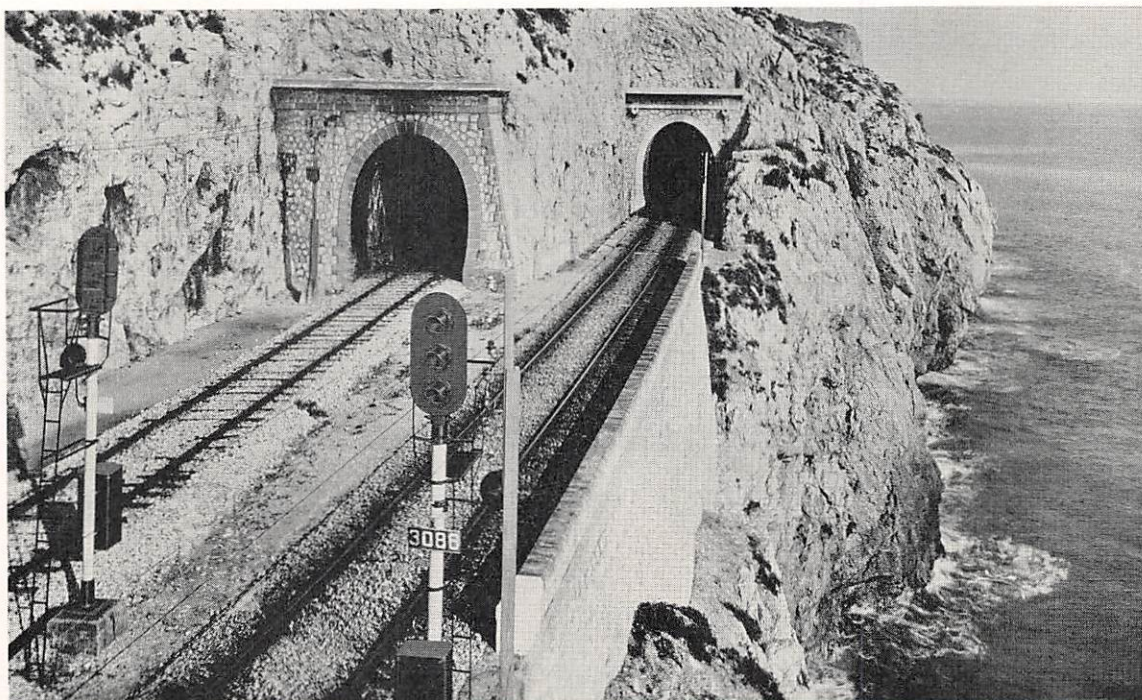


Figure 27. Type D color-light signals on the Spanish National Railways along the Mediterranean coast.

TYPE D COLOR-LIGHT SIGNAL

Type D signals consist of one or more individual light units. Multiple-aspect Type D signals, Figure 27, are made up by bolting together the required number of light units. Each case is accurately machined on top and bottom so that the units line up properly.

Figure 28 shows the construction of the Type D light unit. The inner lens (5-1/2 inches diameter) is colored as required, the outer lens (8-3/8 inches diameter) is clear and is available for various light distributions. The entire lens assembly, either lens, or the lamp, may be removed and replaced without disturbing the focal adjustment. Stepped surfaces of lenses are enclosed in a dust-proof compartment - only smooth surfaces are exposed. This makes it easy to keep the lenses clean.

SIGNALS

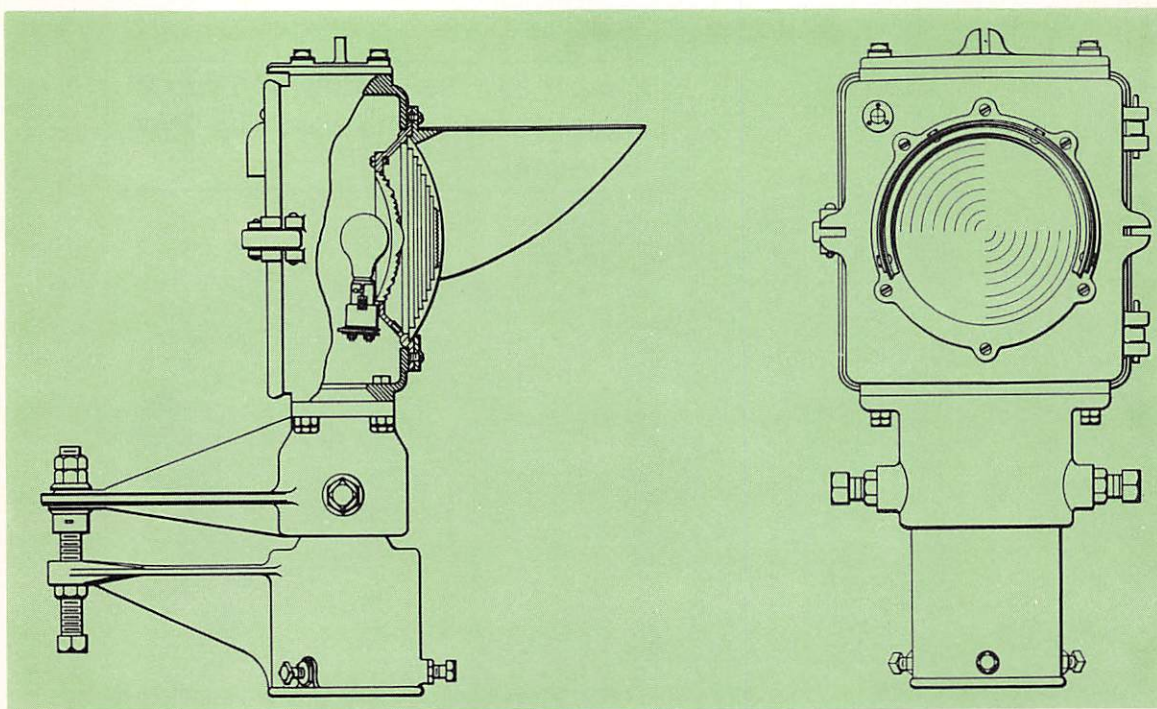


Figure 28. Cutaway views of Type D light unit and mounting bracket.

A hair-line sighting device and an adjustable mounting bracket simplify aiming the signal.

Each light-unit case has room for a G-R-S Type K Size 1/2 transformer. If desired, any light unit may be equipped with a small backlight so that you can see the aspect when looking at the back of the signal. This backlight has a separate roundel and need not be the same color as the signal aspect. Backgrounds are available to fit one-, two-, three-, or four-aspect signals.

The unit construction of the Type D signal reduces inventory requirements, as you can make up signals as required from the basic light units. You can also add or subtract light units as changes in your system demand.

A 3-unit Type D signal head complete measures 4 feet 5-1/2 inches high, 2 feet wide, and 25-1/2 inches deep. Lens centers are spaced 13-3/4 inches apart. Weight is about 223 pounds.

RAILWAY SIGNAL APPLIANCES

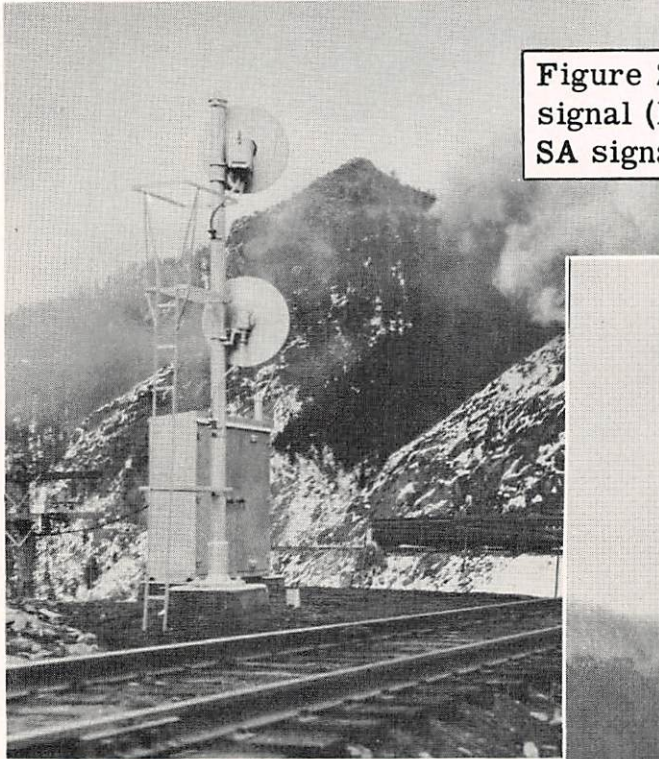


Figure 29. Rear view of Type W signal (lower arm) used with Type SA signal.



Figure 30. Type W signal (lower arm) used with Type SA signal.

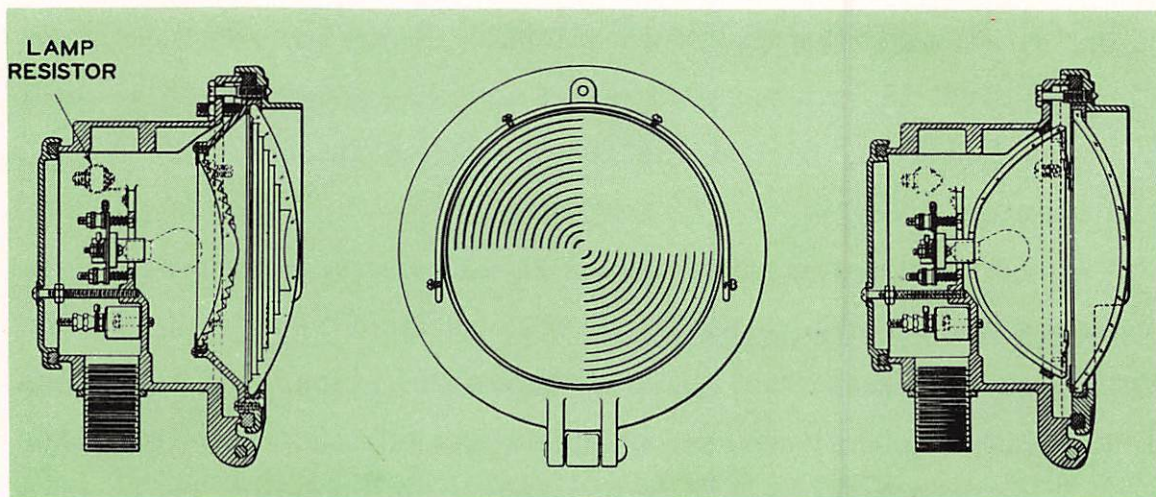


Figure 31. Type W signal with doublet lens system (left) and with reflector and roundel (right).

SIGNALS

TYPE W SIGNAL FOR FIXED INDICATION

The Type W signal is available with background and mounting to match the Type SA signal or for use wherever a fixed signal is required.

Figures 29 and 30 show typical uses of the Type W signal both with and without background, as a single-aspect signal below a Type SA signal.

Figure 31 shows sectional drawings of the light units. There are two lens systems available, the doublet lens, Figure 31, left, and the reflector and roundel system, Figure 31, right. The doublet lens signal matches the stepped lens Type SA signal, and the reflector signal matches the compound lens SA signal. Either arrangement is available in your choice of standard signal colors.

The doublet-lens signal has a close-up bullseye in the center of the outer lens. The outer lens may be furnished to project either a cylindrical beam of light, for tangent track, or a beam with a total horizontal spread of 30 degrees.

The reflector signal has no close-up arrangement, but may be supplied with any of a large variety of spread and deflecting outer roundels (see typical beam patterns in Figure 26, page 43.)

The mounting provides both horizontal and vertical adjustment. You can mount the signal on either side of the mast, as shown in Figures 29 and 30, or directly in front of the mast. When mounted on the side of the mast, the distance from the centerline of the mast to the centerline of the signal is 9 inches, same as for the Type SA signal.

A variable resistor is also available to adjust lamp voltage. It may be mounted inside the lamp case as shown in Figure 31. The front of the lamp case is hinged so that it may be opened to replace lamps or for cleaning.

A Type W unit, complete with background, measures 35 inches high, 35 inches wide, and 18-3/4 inches deep. Weight is about 65 pounds.

RAILWAY SIGNAL APPLIANCES

TYPES MD AND ME COLOR-LIGHT SIGNALS

These are compact, two-aspect dwarf signals with doublet lens systems.

Type MD, Figure 33, has space inside for a relay as shown, or for a relay and a transformer. It also has a shield to keep the signal from appearing to be lighted when the door is open. These are the only important differences from the Type ME signal, Figure 34.

These signals may be furnished with variable resistors (one for each lamp) to control the lamp voltage.

Inner lens is 5-1/2 inches in diameter, outer lens, 6-3/8 inches. Various outer roundels are available to spread or deflect the light as required. Inner lenses may be any standard signal color.

Doors are hinged at bottom. When open, they allow full access to the interior of the signal. Housings are of one-piece cast construction. When mounted on a level foundation, they tilt the front of the signal backward slightly to bring the center of the light beam up to the trainman's eye level at the normally desired distance.



Figure 32. Type MD signals in a large interlocking on the Southern Railway, Atlanta, Georgia.

SIGNALS

The Type ME signal may be furnished with backlights, colored as required.

Dimensions for Type MD are: height 17-5/8 inches, width 12 inches, depth 17-15/16 inches. Weight is about 65 pounds. Dimensions for Type ME are: height 17-1/4 inches, width 10 inches, depth 11-9/16 inches. Weight is about 50 pounds.

Types MD and ME signals are in wide use in interlockings throughout the United States. They are simple and economical.

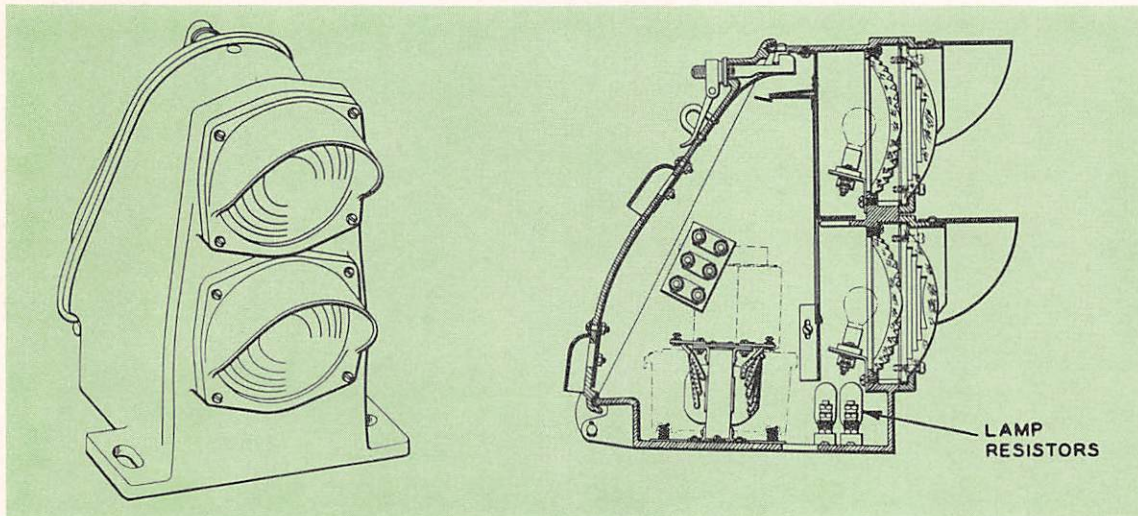


Figure 33. Type MD signal cut away to show how Type K, Size 4 relay can fit inside housing.

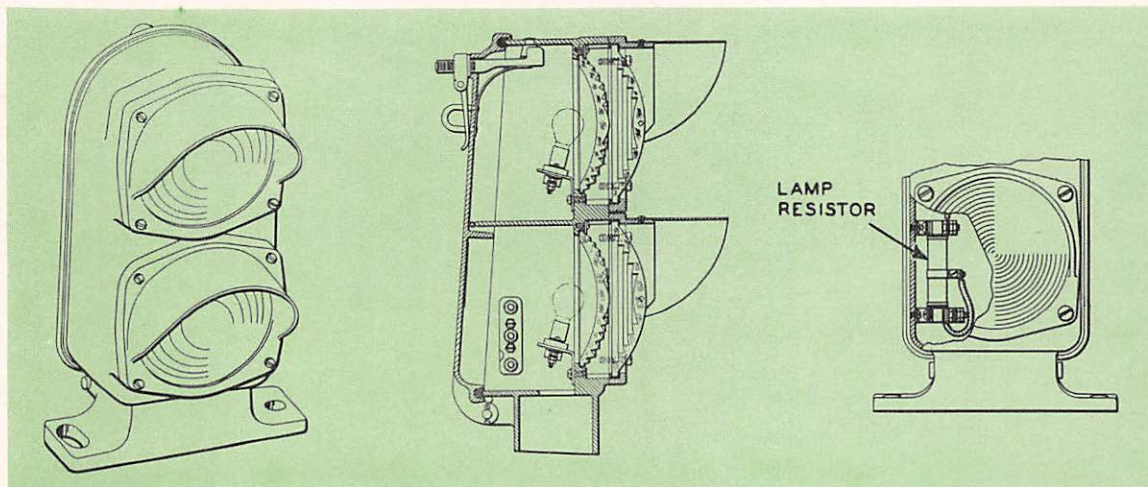
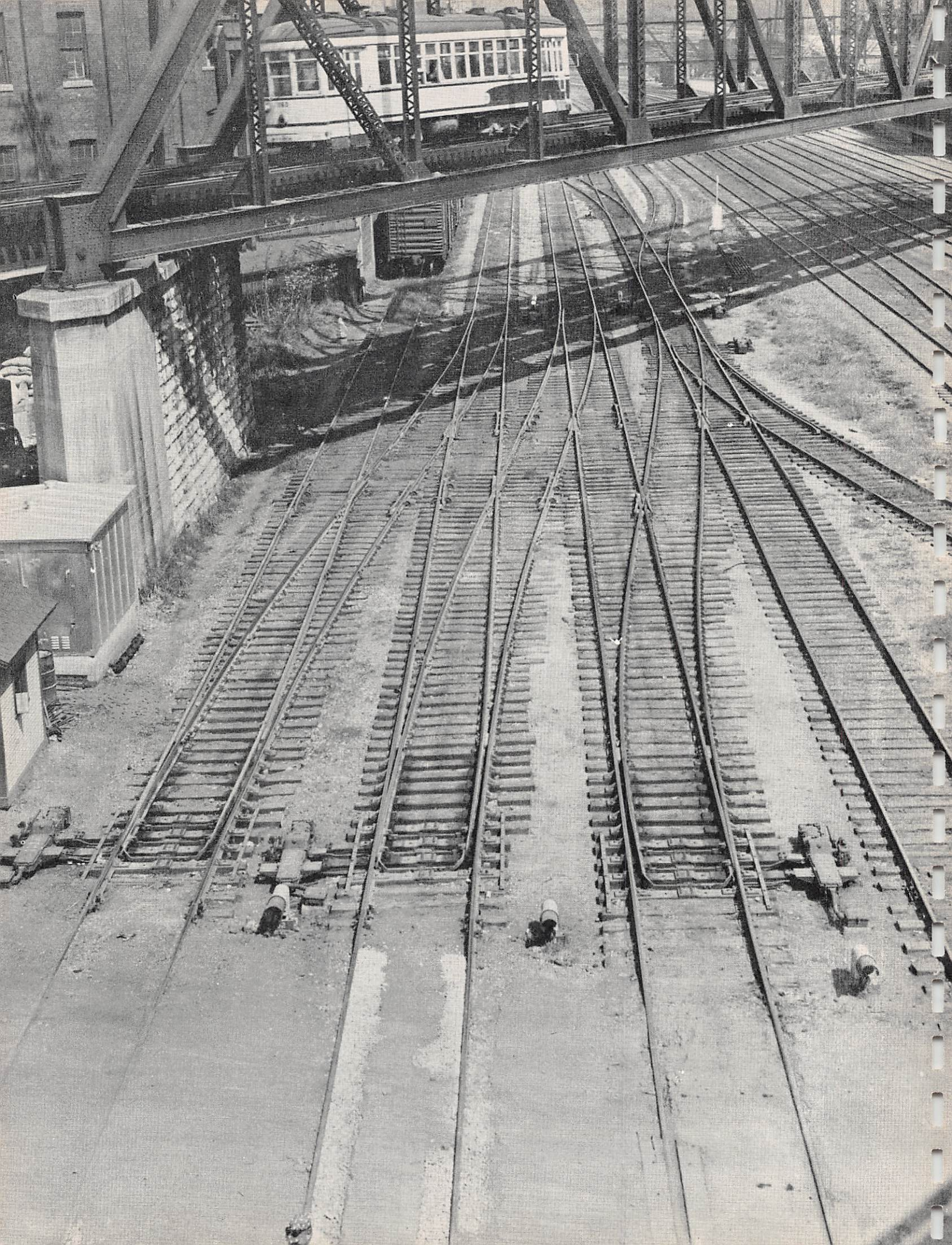


Figure 34. Type ME signal. View at right shows location of lamp voltage regulating resistor.



SWITCH MACHINES

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RAILWAY SIGNAL APPLIANCES

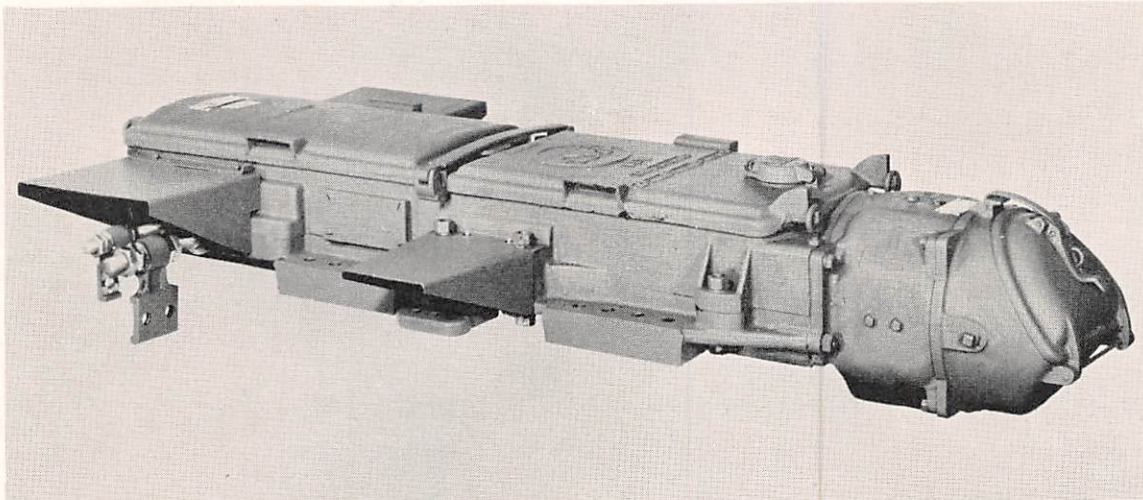


Figure 35. Model 5A electric switch machine.

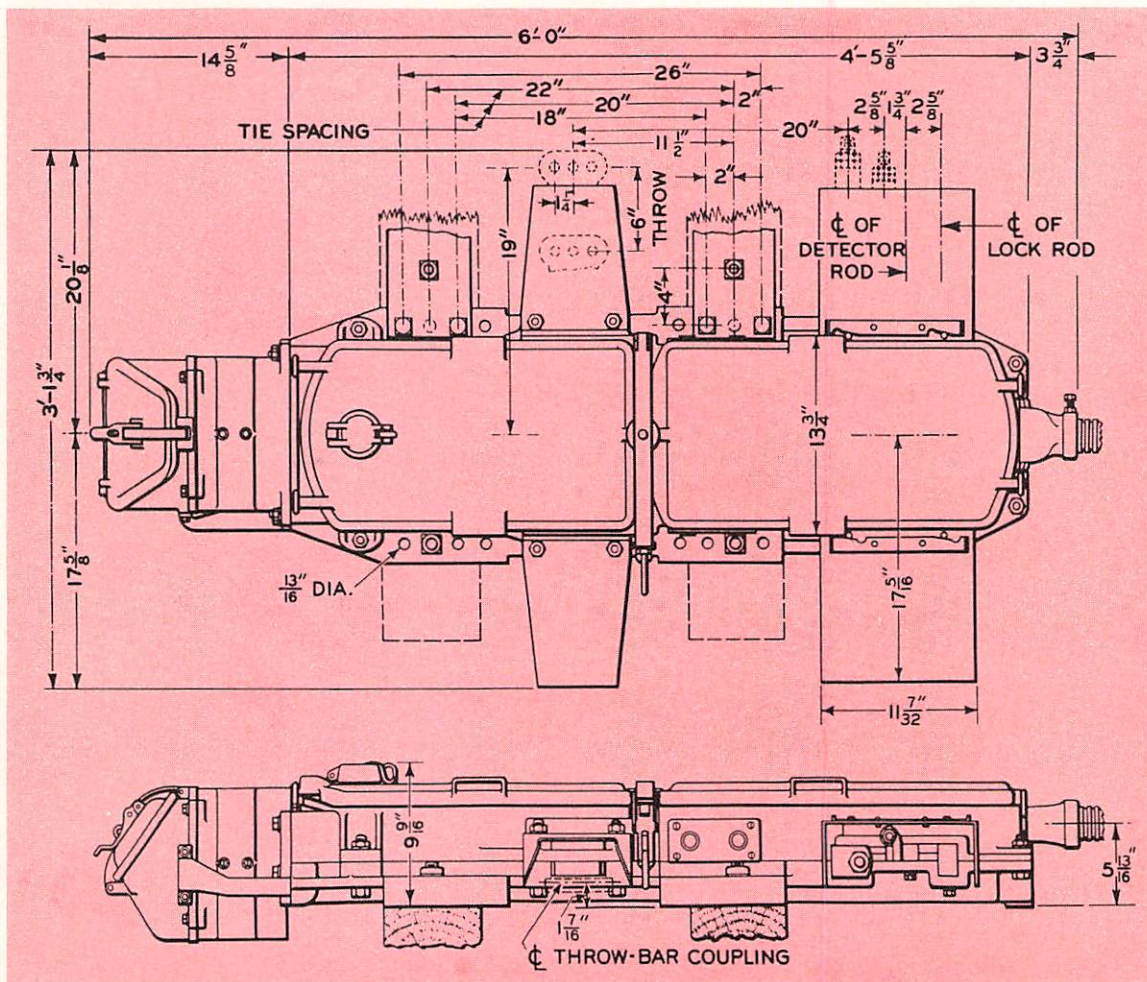


Figure 36. Dimensions of Model 5A switch machine.

SWITCH MACHINES

MODELS 5A, B, C, AND D ELECTRIC SWITCH MACHINES

These four Models of G-R-S electric switch machines cover all requirements for electric switch and lock movements for use in electric interlocking, relay interlocking, automatic interlocking, remote control, or centralized traffic control systems. Operation is powerful yet not so violent as to be a strain on switch fittings.

The principal differences among the four models are that Models 5A and B are designed primarily for direct operation through the control lever, without intervention of any relay. Models 5C and D are for operation through relay control. Models 5B and D have dual-control mechanisms so they can easily be hand operated when required. All models are reversible in midstroke.

Model 5A Switch Machine

The Model 5A switch machine, Figures 35 and 36, is a compact, self-contained, powerful mechanism. It has all features required in meeting interlocking requirements. It fits all switches, regardless of variation in fittings or weight of rail.

It is a single unit, designed for two-tie support. The essential parts are motor, gearing, operating and locking members, pole-changer, point-detector of the over-and-locked type, and lock and detector rod combinations to fit any specified requirements.

Pole-changer contacts operate mechanically at end of stroke or electrically if the controlling lever is reversed in mid-stroke.

The Model 5A is designed primarily for use where the motor operating energy flows directly from a central source, through the controlling lever, through the built-in pole changer, and through the switch machine motor. If desired, it can also be operated by local energy applied through an external local control relay.

RAILWAY SIGNAL APPLIANCES

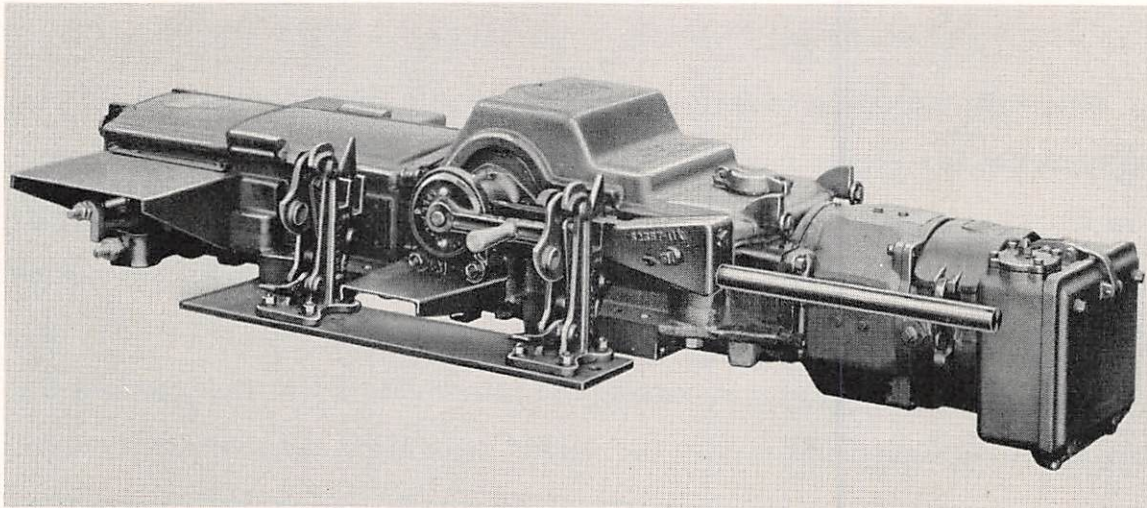


Figure 37. Model 5B electric switch machine.

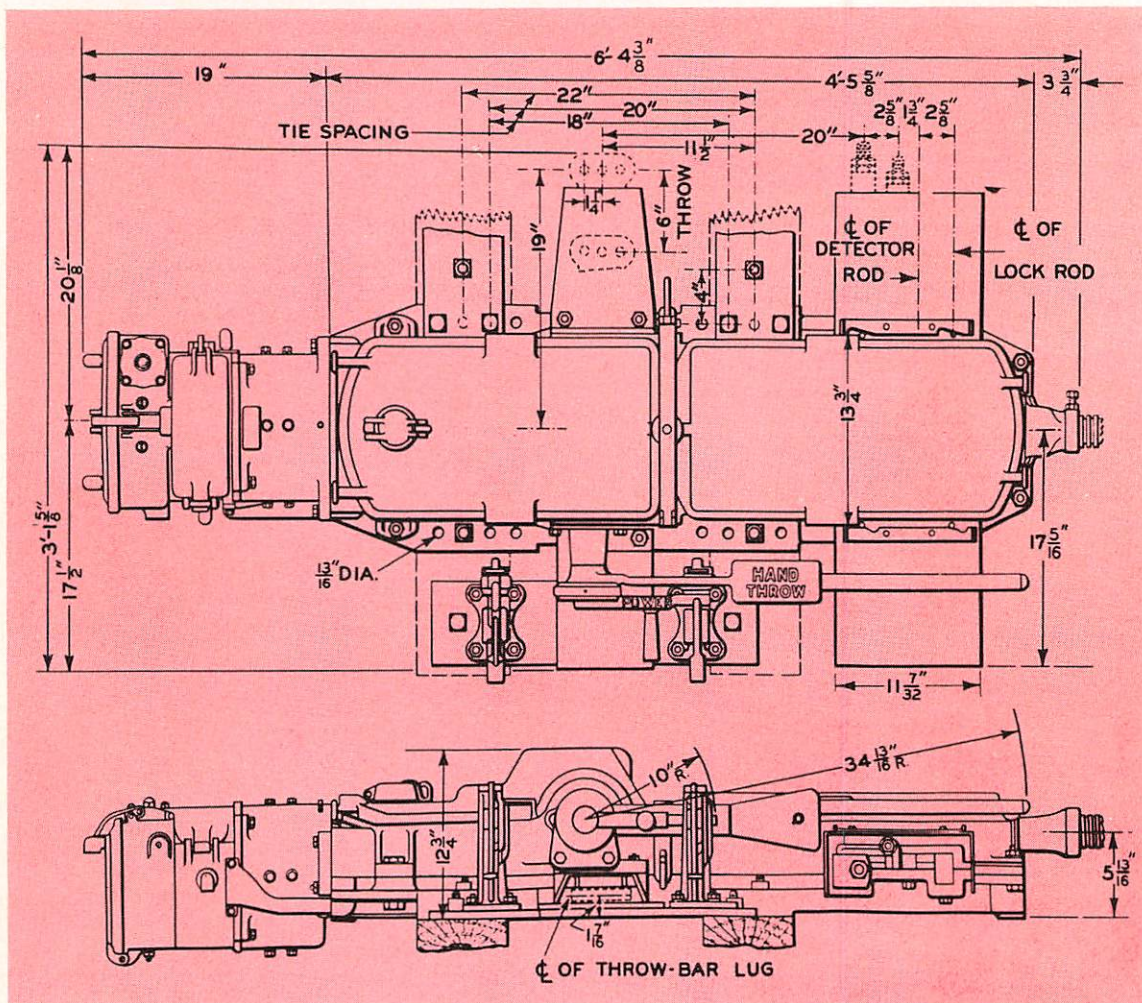


Figure 38. Dimensions of Model 5B switch machine.

SWITCH MACHINES

Operating energy may be 110 volts, 60 cycle or 25 cycle a.c.; or 110 volts d.c.; or 24 to 32 volts d.c.

Current requirements, using d-c. motors, vary from 1.25 to 7 amperes; operating time, from 3 to 15 seconds. These factors are dependent upon voltage, gear ratio, weight of rail, and condition of switch.

The usual control and operating circuit requires three wires, one for normal, one for reverse, and a common return. Indication may be dynamic or relayed battery.

The Model 5A has a friction clutch for protecting the gearing. An electric brake, to hold the motor and gear train immovable when the motor is not energized, is optional equipment. A hand crank is provided for maintenance use; otherwise the machine is for electric operation only. If you wish to provide means for trainmen to control a Model 5A (or a Model 5C, page 56) switch machine electrically at the switch location, this can be done with pushbuttons or a miniature lever.

Shipping weight is 1050 pounds.

Model 5B Switch Machine

The Model 5B, Figures 37 and 38, is similar to the Model 5A except that it has a dual-control mechanism so that trainmen can easily hand throw the switch when it is convenient to do so. A hand crank is also provided for maintenance use.

High-voltage, high-speed machines are furnished with a friction clutch; others have a resilient gear. An electric brake is usually furnished. Shipping weight is 1550 pounds.

RAILWAY SIGNAL APPLIANCES

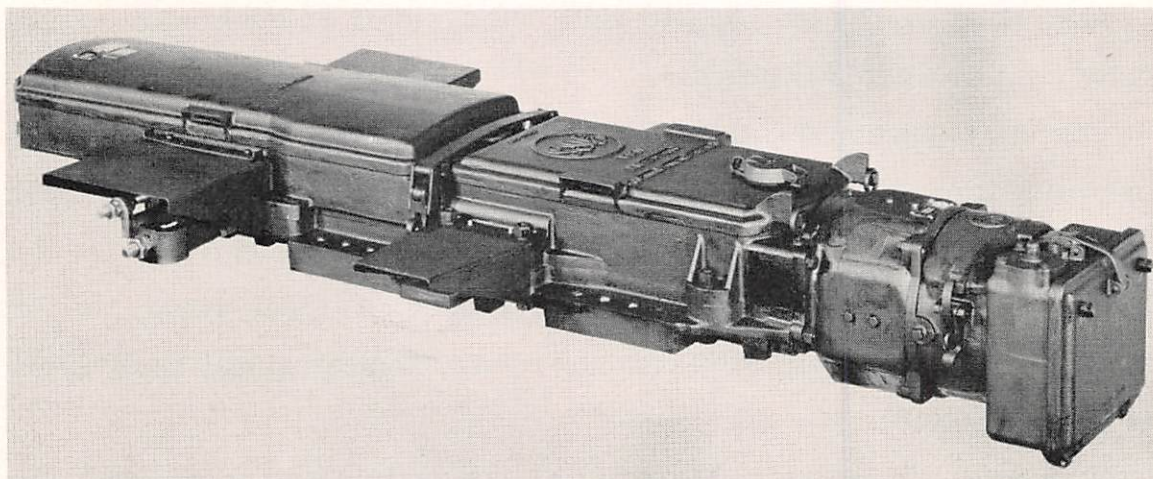


Figure 39. Model 5C electric switch machine.

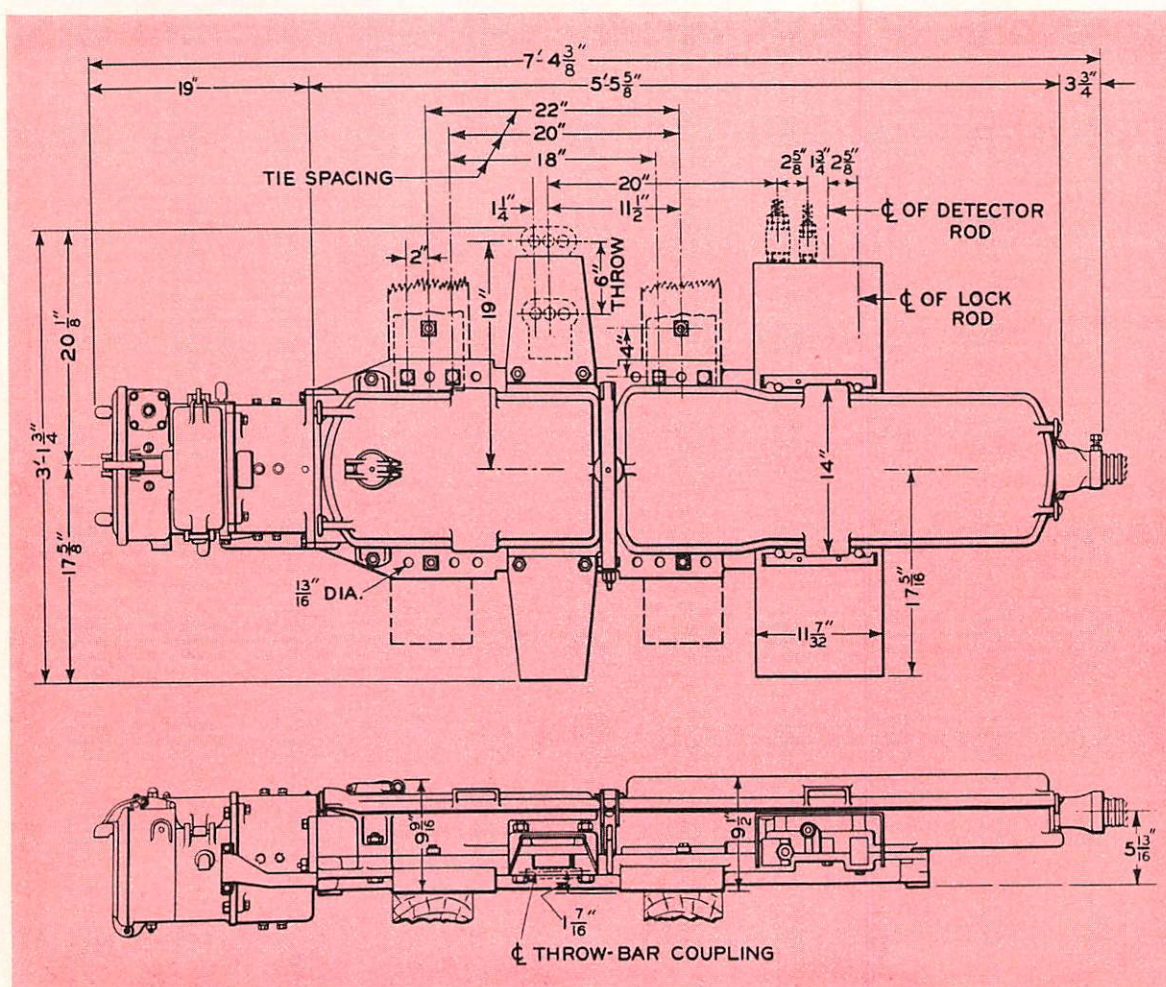


Figure 40. Dimensions of Model 5C switch machine.

SWITCH MACHINES

Model 5C Switch Machine

The Model 5C machine, Figures 39 and 40, is like Model 5A except that it is designed for relay control. It is available for d-c. operation only, and it is regularly supplied with a friction clutch and an electric brake.

The controller is a compact unit housed in a metal case resiliently mounted inside the machine. The controller consists of an overload relay and two biased-neutral contactors.

The magnetic structure of each biased-neutral contactor is such that it will operate only when current flows through its windings in a specific direction. This feature provides for two-wire polarized control of the Model 5C machine, either over line or by means of local control relays. Operating energy to the switch machine is controlled through the heavy-duty contacts of the biased-neutral contactors. Permanent magnet blow-outs provide for instant quenching of any arc at the contacts.

The overload relay acts to deenergize the contactors if the motor draws excessive current, such as when an obstruction jams the switch. Reversing the controller energy automatically resets the overload relay to permit operating the machine in the opposite direction.

Model 5C machines are for direct-current operation from 110 volts or from 24 to 32 volts.

Operating current requirements vary from 4 to 6 amperes; operating time, from 3 to 10 seconds. These factors are dependent upon voltage, gear ratio, weight of rail, and condition of switch.

Controllers are available for direct current operation from 10 to 12 volts or from 20 to 24 volts.

The Model 5C is for battery indication only.

High-voltage, high-speed Model 5C machines are furnished with a friction clutch; others have a resilient gear. An electric brake is regularly furnished. Shipping weight is 1300 pounds.

RAILWAY SIGNAL APPLIANCES

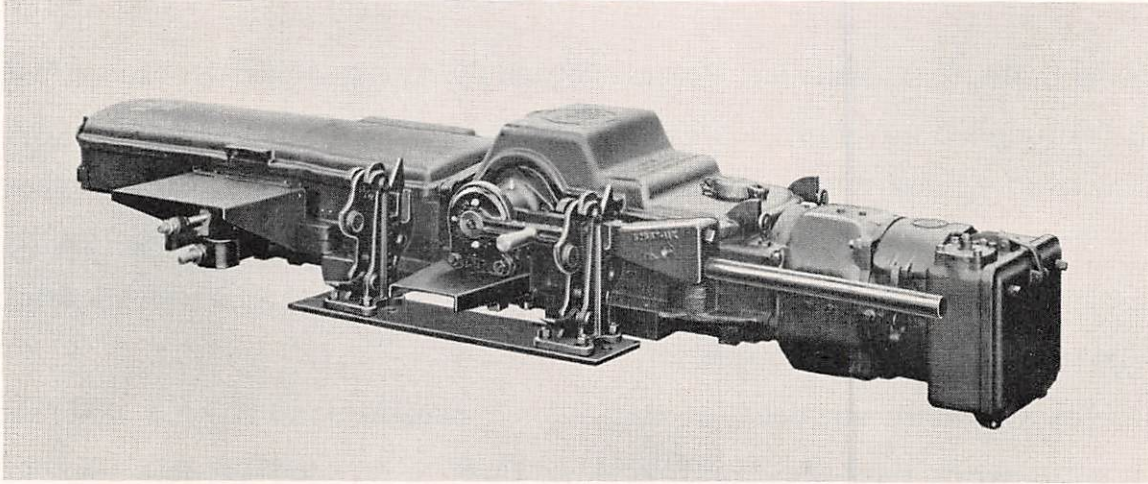


Figure 41. Model 5D electric switch machine.

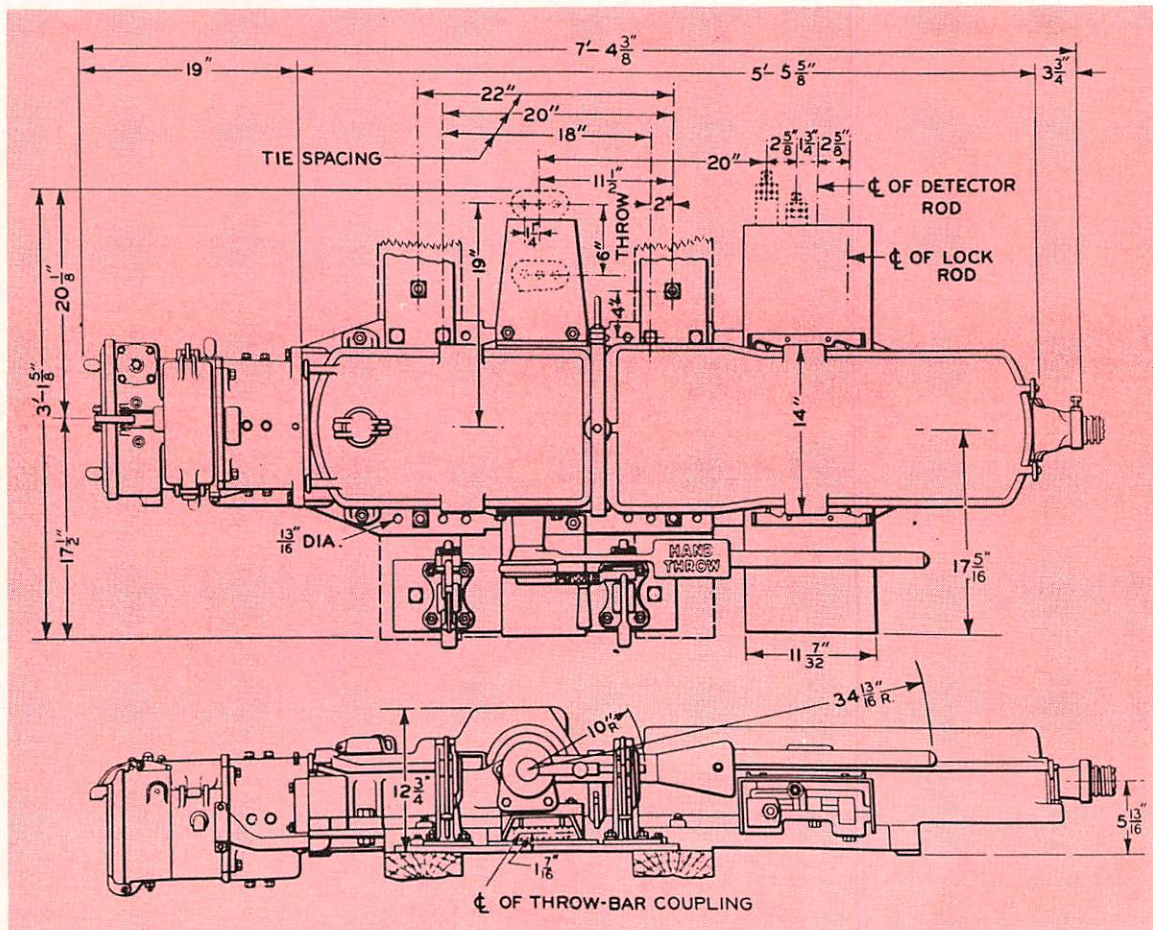


Figure 42. Dimensions of Model 5D switch machine.

SWITCH MACHINES

Model 5D Switch Machine

The Model 5D, Figures 41 and 42, is the same as the Model 5C except that it also has the dual-control mechanism for convenient hand operation. Thus the Model 5D has three desirable features all in the one machine: dual control, electric brake, and built-in controller.

Shipping weight is 1580 pounds.



Figure 43. Typical installation of G-R-S Model 5A electric switch machine.

RAILWAY SIGNAL APPLIANCES

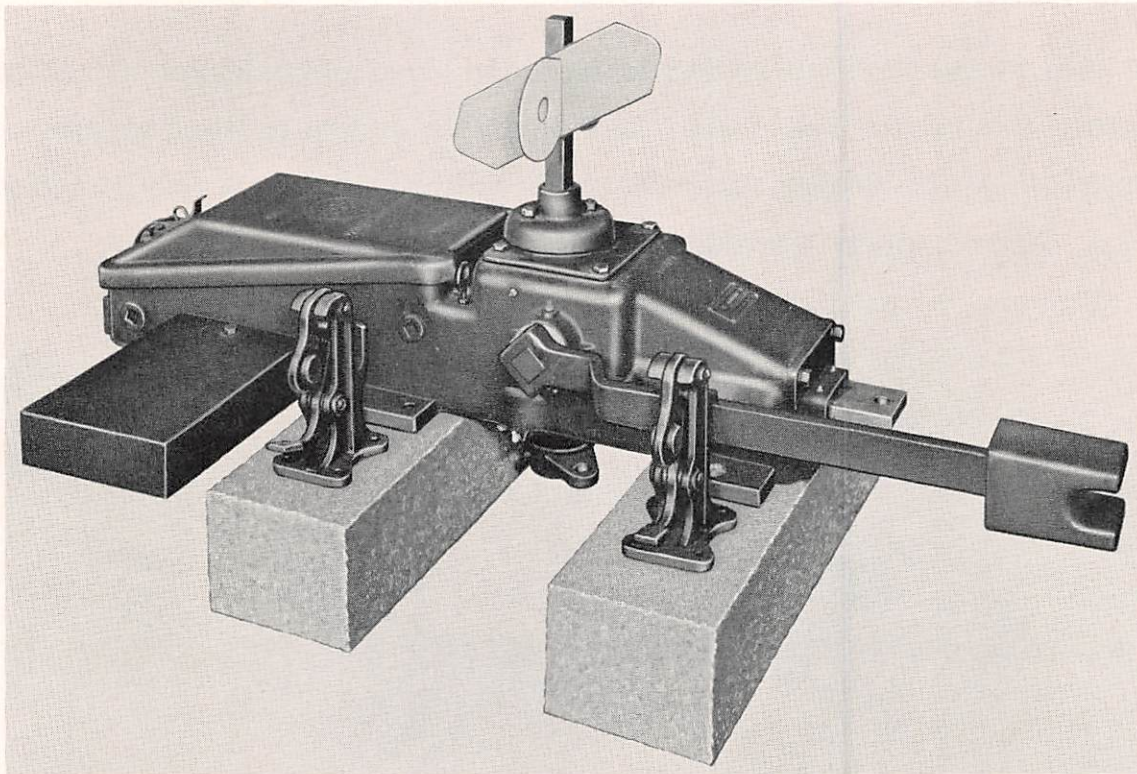


Figure 44. Model 9 hand-operated switch machine, field side.

MODEL 9 HAND-OPERATED SWITCH MACHINE

The Model 9 switch machine, Figures 44 and 45 comprises a hand-throw switch stand, a facing point lock, and circuit controllers, all in one compact unit. Electric locking may be added if desired, see Figure 47.

Switch Stand

The switch-throw mechanism is self-locking at the ends of its stroke. The throw crank locks the switch rigidly in position through the throw rod. You get the effect of an extra lock rod. Target and lamp staffs of various heights are available if required. A derail can be connected to the locking plunger.

SWITCH MACHINES

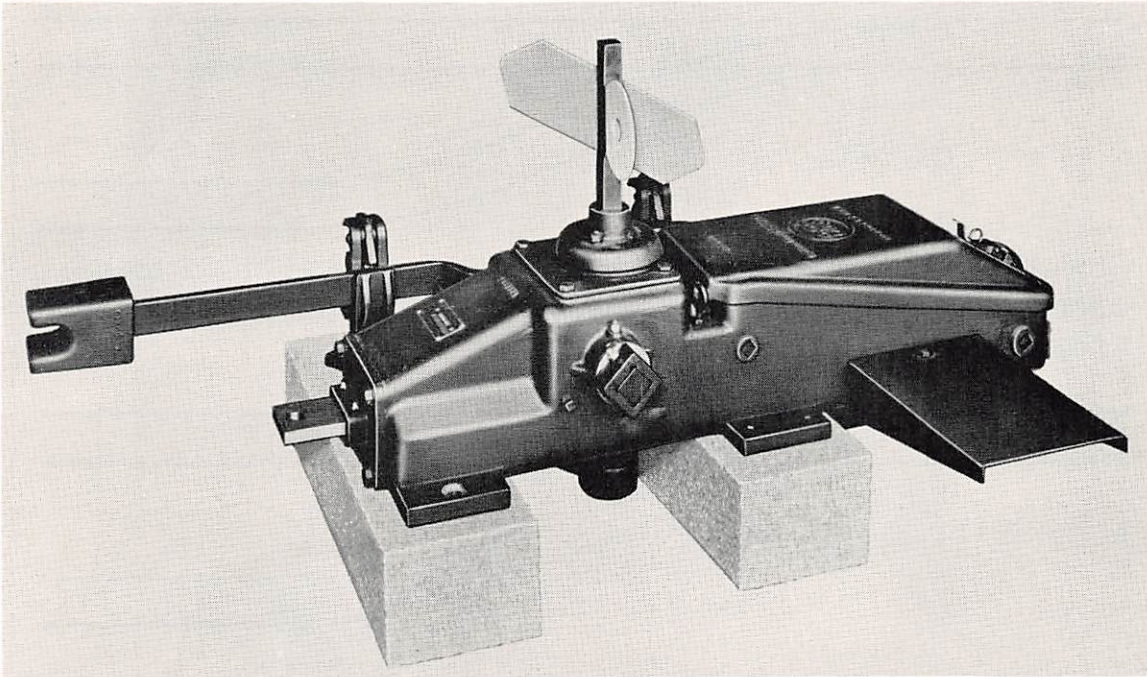


Figure 45. Model 9 hand-operated switch machine, track side.

Switch Point Locking

The lock rod may be arranged to lock normal only or both normal and reverse. Locking may be controlled by the hand-throw lever or through mechanical linkage from a tower lever or another Model 9 machine.

Circuit Controllers

Built-in circuit controllers check both switch position and locking, in the normal position only or in both positions. Contacts latch in "switch unlocked" position if switch is accidentally trailed through when positioned normal. Contacts remain latched out until reset by maintainer or until machine is operated to reverse and then back to normal.

Electric Locking

The G-R-S Model 10 electric lock (page 70) can be used to lock the hand-throw lever normal or both normal and reverse.

RAILWAY SIGNAL APPLIANCES

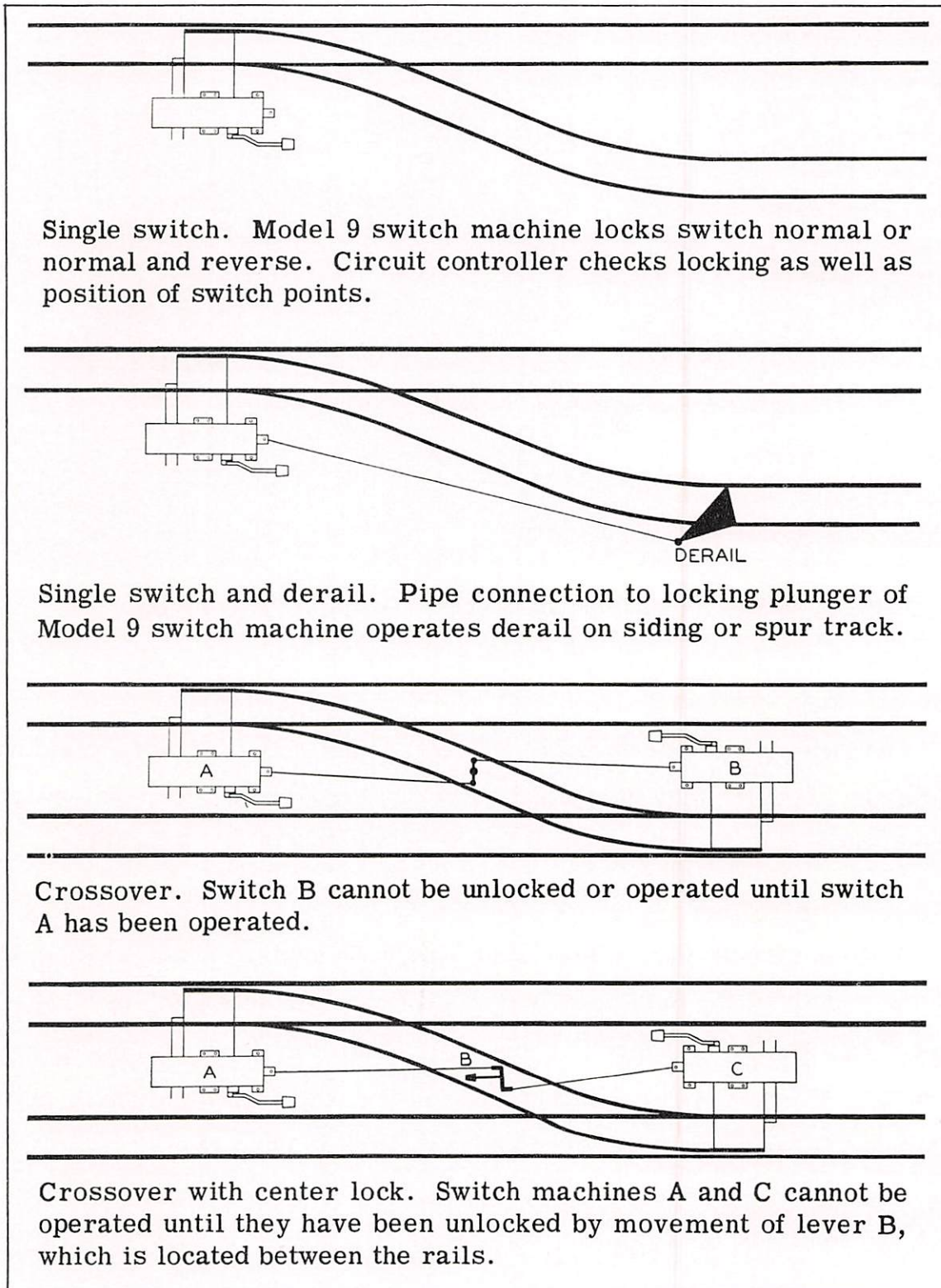


Figure 46. Various uses of the Model 9 hand-operated switch machine.

SWITCH MACHINES

Applications

As shown in Figure 46, the Model 9 machine may be used wherever you want a fully interlocked hand-operated switch. The machine is easily arranged for right- or left-hand operation on the normally closed-point or on the normally open-point side of the switch.

Dimensions are: height (less target) 10 inches, width 39-1/4 inches, length (including lever) 64 inches. Shipping weight is 780 pounds.

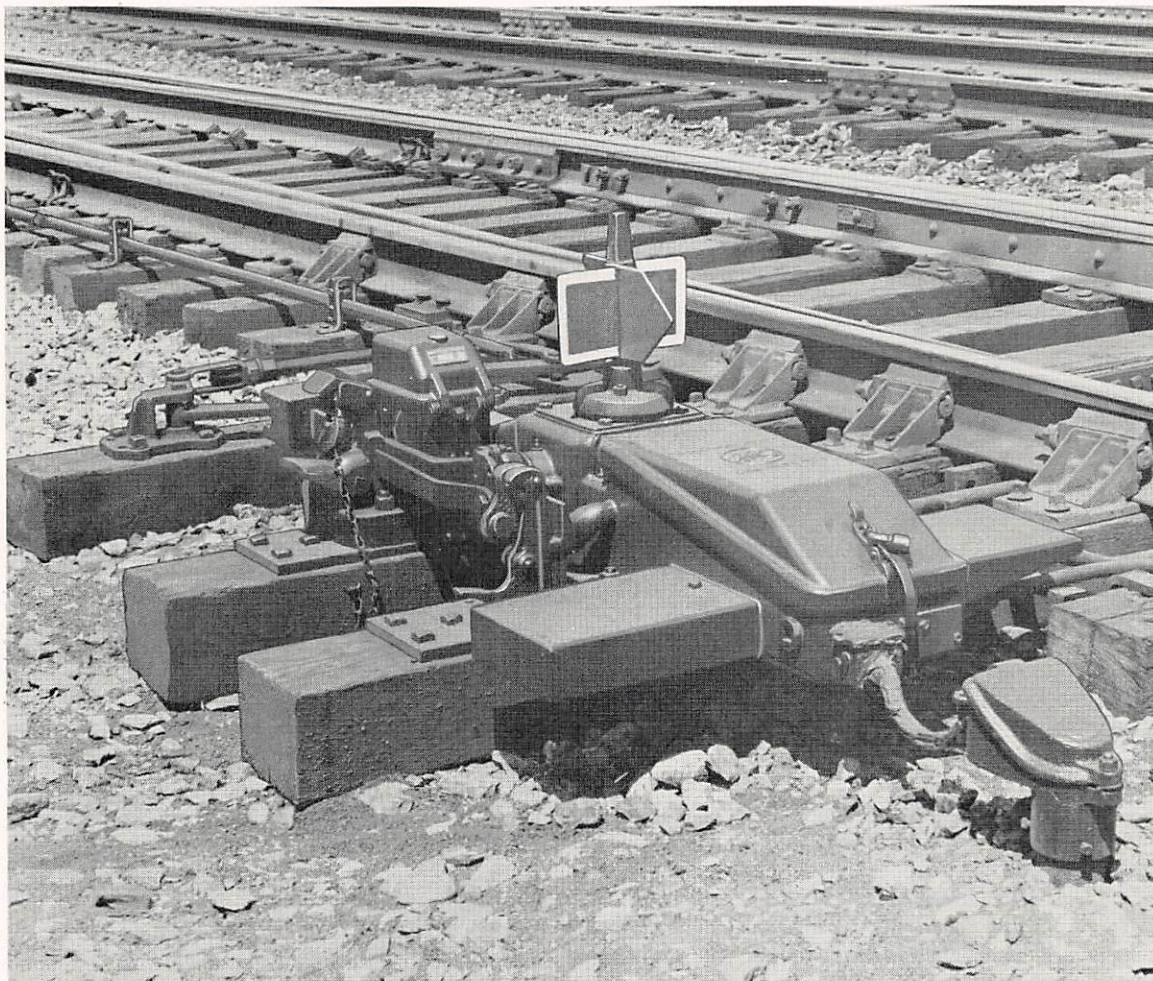
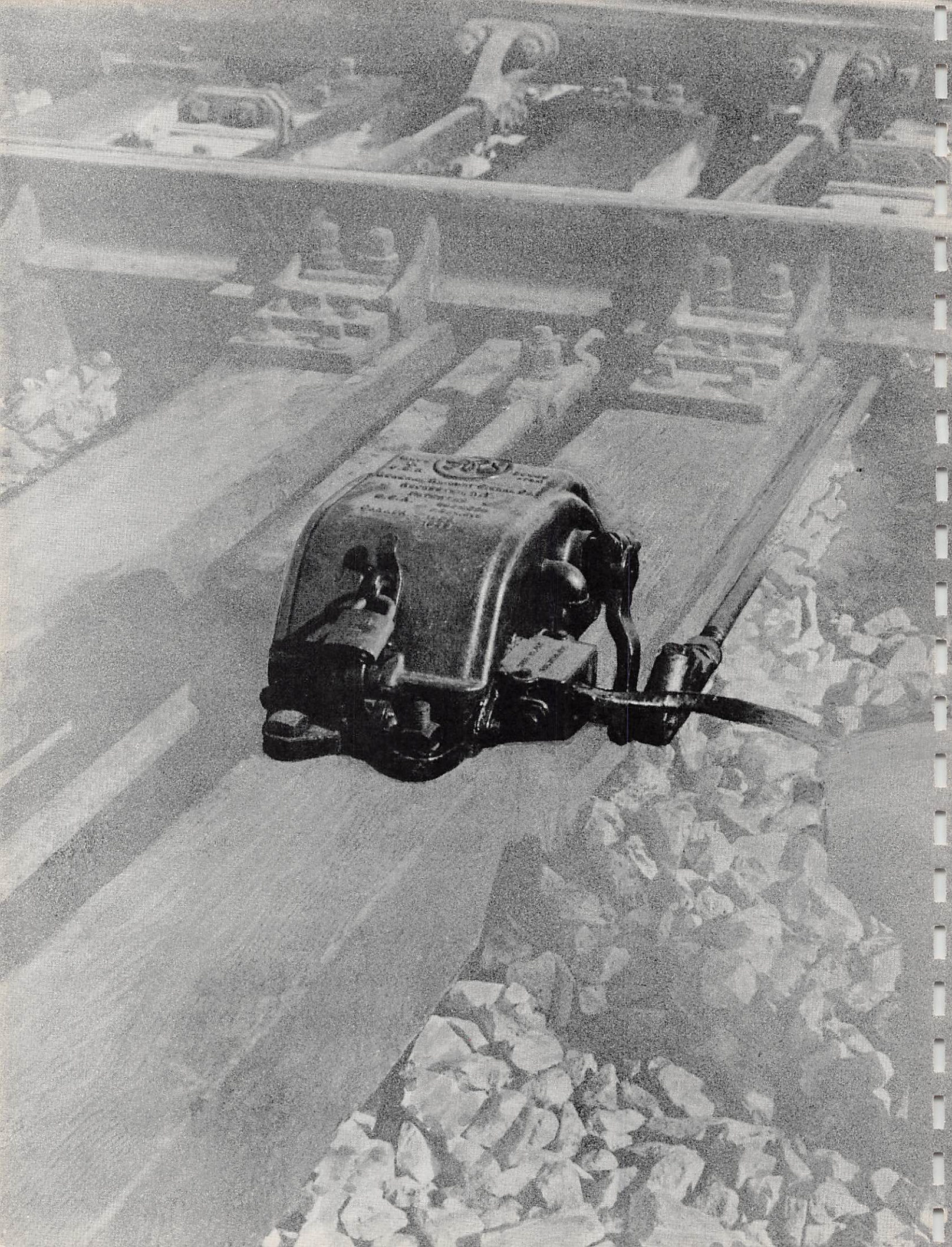


Figure 47. Model 9 switch machine with Model 10 electric lock and pipe connection to operate derail.



SWITCH CIRCUIT CONTROLLERS

RAILWAY SIGNAL APPLIANCES

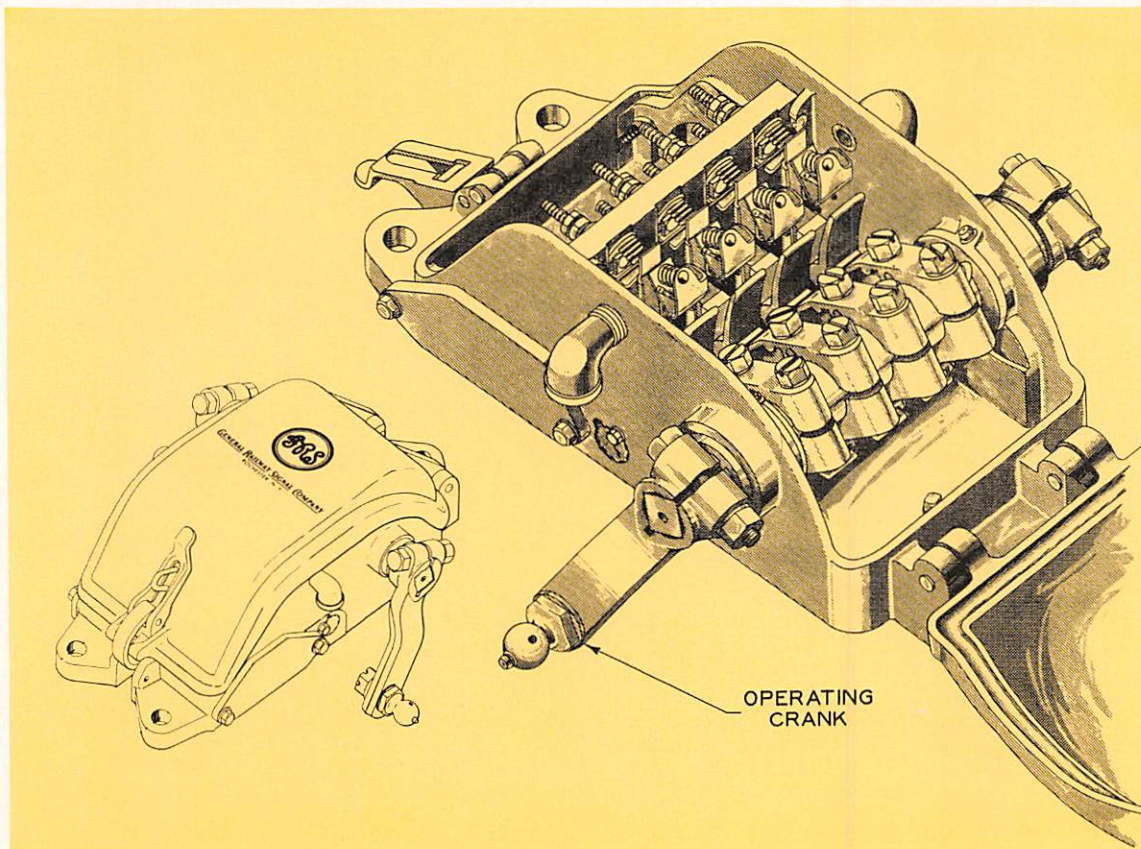


Figure 48a. Model 8 switch circuit controller.

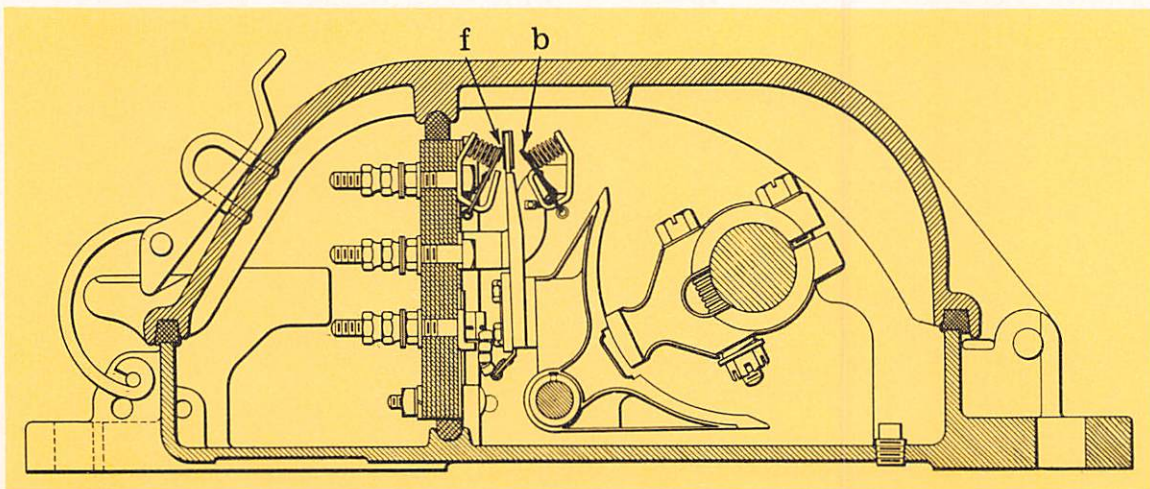


Figure 48b. Model 8 controller, cross section view.

SWITCH CIRCUIT CONTROLLER, MODEL 8

The Model 8 switch circuit controller, Figure 48a, is used for track shunting, switch position detection, and signal control at switch locations.

A 3/16-inch movement of the switch points opens the front contacts and closes the back contacts. Moving the operating crank clockwise, Figure 48b, turns the main shaft, causing the cam to strike the upper shoulder of the depression in the rocker arm. The contact finger, bolted to the rocker, strikes the "f" contact to complete the signal circuit. Turning the crank in the opposite direction reverses the movement causing the contact finger to strike the "b" contact.

This construction insures correct operation even under adverse operating conditions. Vibration has no effect on the contacts, as the cams slide on the extensions of the rocker arms without moving the contact fingers.

The operating crank can be ordered with an insulated or non-insulated ball stud, as required. With crank, the controller weighs approximately 60 pounds. It measures 6-15/16 inches high, 7-7/8 inches wide, and 18-1/2 inches long. Maximum throw of operating crank is 5-1/2 inches.

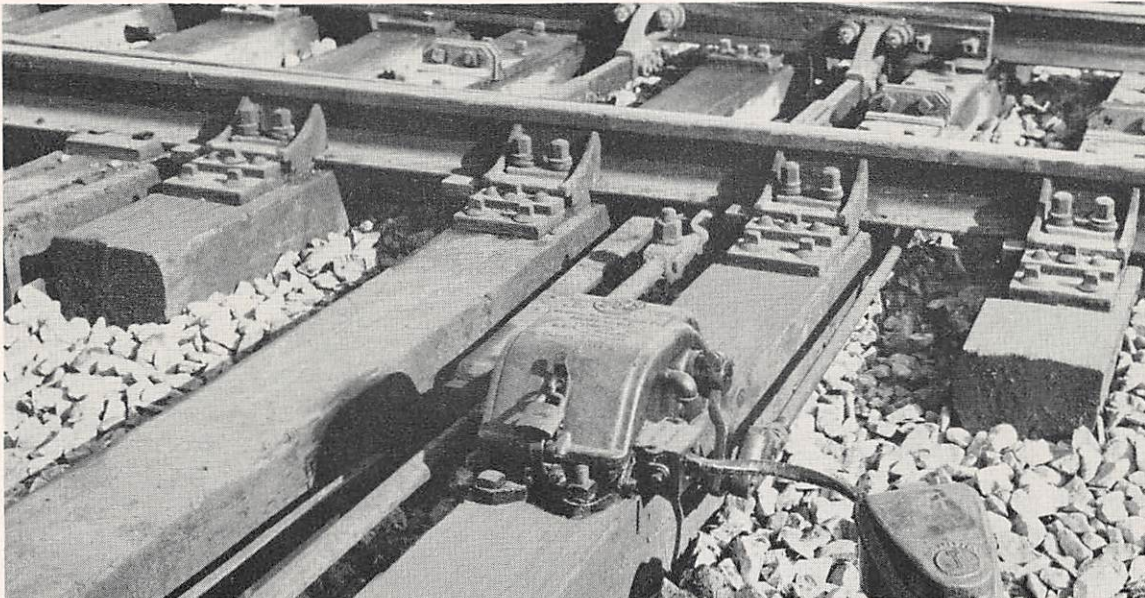
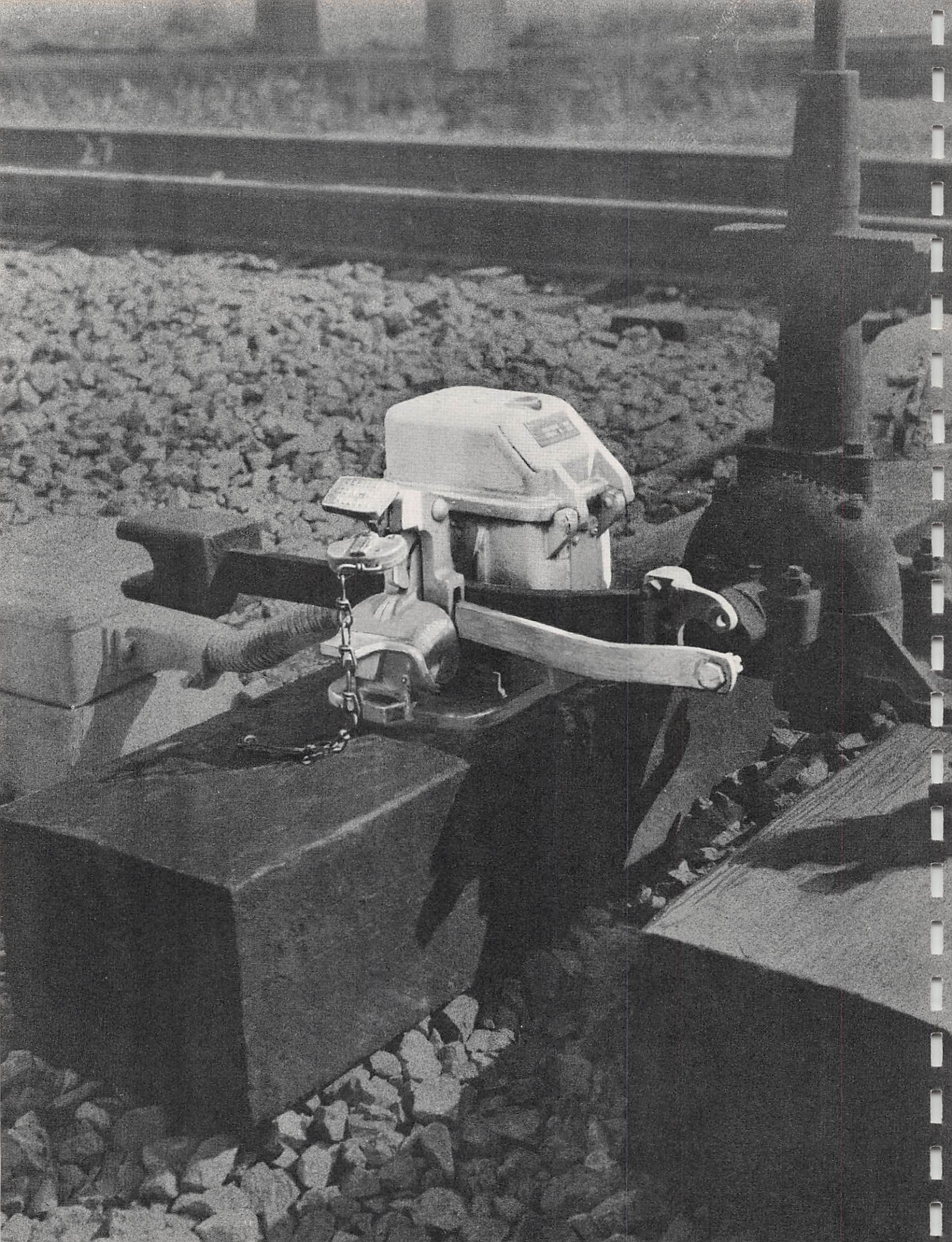


Figure 49. Typical installation of Model 8 switch circuit controller.



LOCKS

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RAILWAY SIGNAL APPLIANCES

ELECTRIC SWITCH LOCK, MODEL 10

For Locking Normal

The Model 10 electric switch lock, Figure 50, provides a means of interlocking a manually operated switch with the signal circuits so that the switch cannot be operated unless traffic conditions permit or unless the normally sealed emergency release is operated.

The Model 10 lock can be applied to most ground-throw switch stands in common use and to hand-operated switch machines. It will lock levers from $3/4 \times 2$ to 1×2 inches in cross section. The same lock may be used on right-hand or left-hand switch layouts. Only two bolts are needed to fasten it to the tie.

The lock is easily operated by depressing the latch and removing the switch padlock. This action puts associated signals to stop. If traffic conditions permit, the lock coils are energized; and an indication lamp, visible through a window in the cover, lights. The lamp indicates that the mechanism is unlocked. The pedal can now be depressed and the hand-throw lever operated.

An interlocked emergency release is provided as an optional feature. It is used if the switch must be unlocked when the normal control circuit does not respond.

There are two wiring outlets in the case, one on each side. The mechanism can be wired to meet various requirements. When ordering, please tell us the type of switch stand you wish to lock.

The shipping weight of the lock is approximately 80 pounds. Height is $11-3/4$ inches, width $12-3/4$ inches, and depth $14-1/4$ inches.

SWITCH LOCKS



Figure 50. Model 10 electric lock on G-R-S Model 9 switch machine.

RAILWAY SIGNAL APPLIANCES

For Locking Normal and Reverse

A tandem attachment, Figure 51, for Model 10 switch locks is available for locking the hand-throw lever of a switch stand or hand-operated switch machine in either the normal or reverse position. The tandem lock, as used within interlocking limits, prevents a trainman from operating a hand-throw switch in either the normal or reverse direction without an electrical release by the towerman. Shipping weight of lock complete with tandem attachment is about 100 pounds.

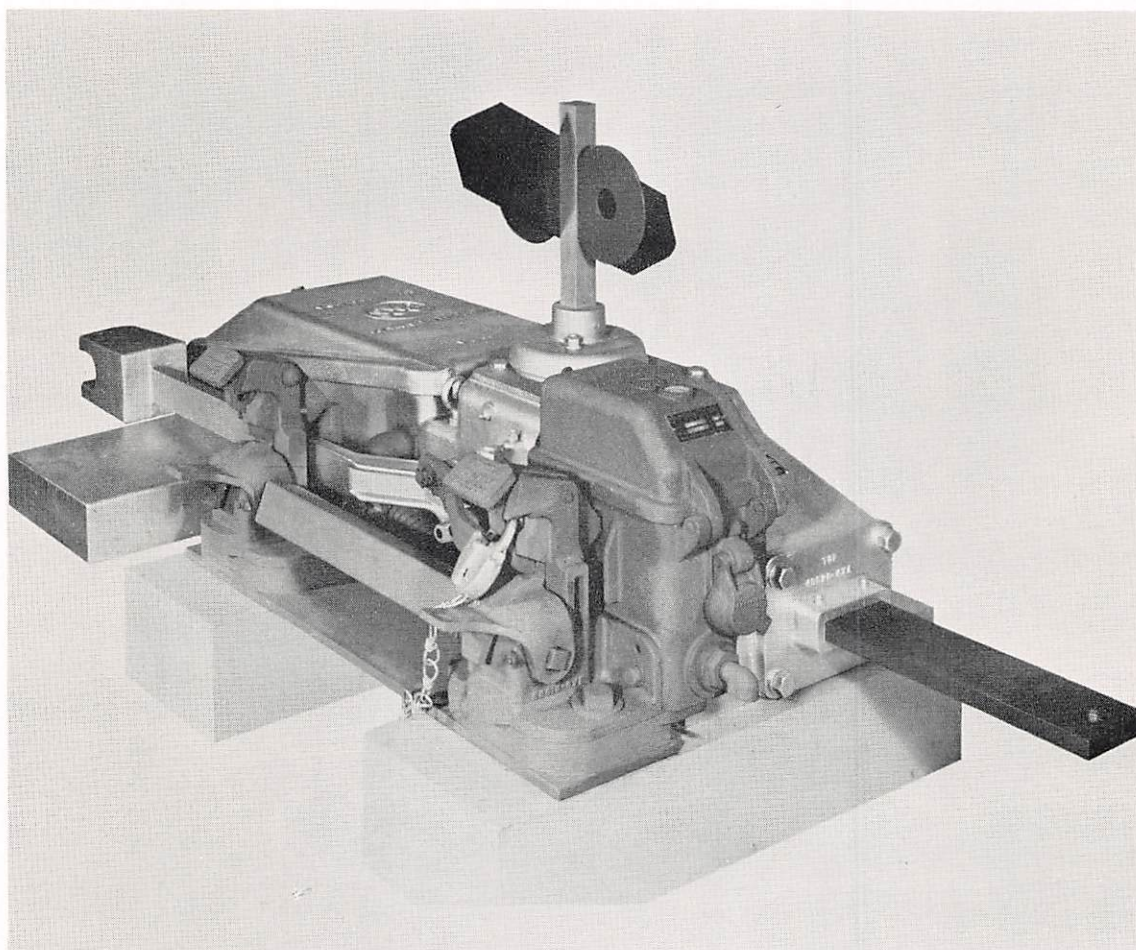


Figure 51. Model 10 electric switch lock with tandem attachment.

SWITCH LOCKS

FACING POINT LOCK, TYPE A

The Type A facing point lock, Figure 52, provides complete interlocking protection for all types of spring switches. All operating features of a spring switch are retained. The Type A lock fits any existing spring switch layout, regardless of the type or grouping of the auxiliary equipment already in service.

The Type A facing point lock consists of two basic units, Figure 53, an escapement mechanism and a lock mechanism. It can be unlocked manually or automatically. Operating the hand-throw lever removes the locking plunger from the lock rod and throws the switch. During automatic unlocking, which occurs when the switch is trailed, the escapement mechanism is operated by a deflection of the switch rail. This deflection is transformed into a rotary movement of the escapement shaft which connects the escapement mechanism with the lock mechanism. In the lock mechanism, this movement withdraws the locking plunger from the lock



Figure 52. Type A facing point lock.

RAILWAY SIGNAL APPLIANCES

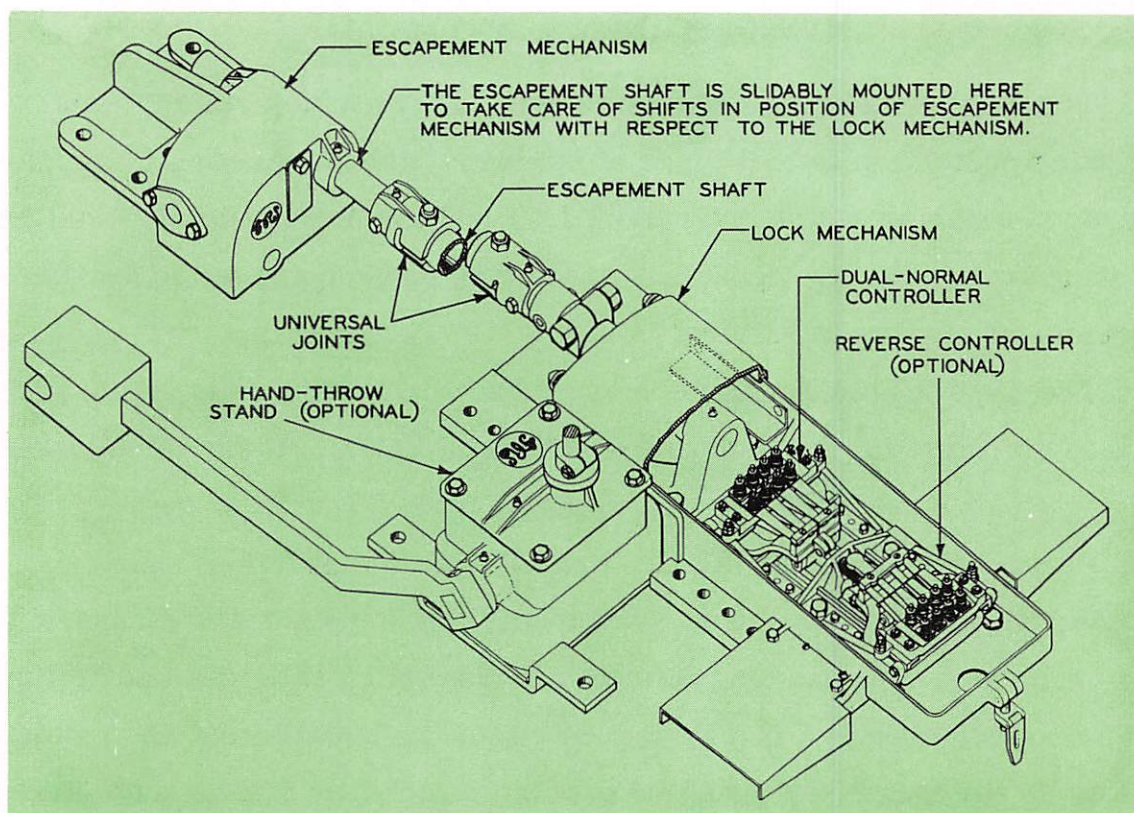
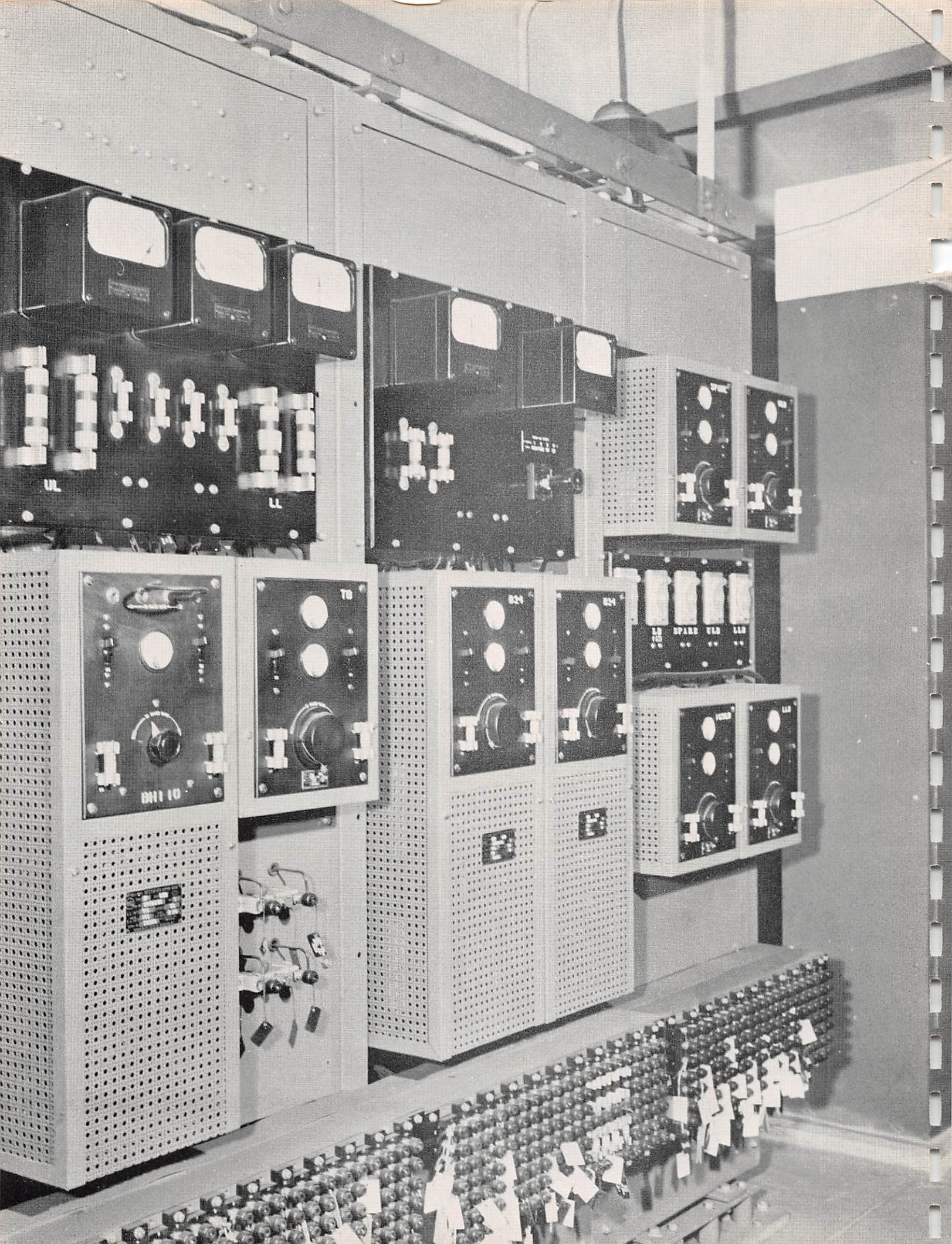


Figure 53. Type A facing point lock equipped with reverse controller and hand-throw mechanism.

rod, releasing the switch. Circuit controllers built into the lock mechanism operate contacts to control the signal aspects.

The Type A facing point lock can be furnished with a built-in hand-throw stand that can be bolted to either side of the case.

The lock equipped with the hand-throw stand weighs approximately 580 pounds; without the hand-throw stand, approximately 465 pounds. The lock mechanism, less target, is 11-1/8 inches high. It mounts on two ties, spaced from 20 to 22 inches apart. It may be mounted as close as 7 feet 10-1/2 inches from centerline of hand-throw lever to the gauge line of the track. The escapement mechanism mounts on one tie, measures 5-7/8 inches high and 11-1/8 inches wide. Distance from lock mechanism to escapement mechanism may be as required.



COPPER-OXIDE RECTIFIERS

RAILWAY SIGNAL APPLIANCES

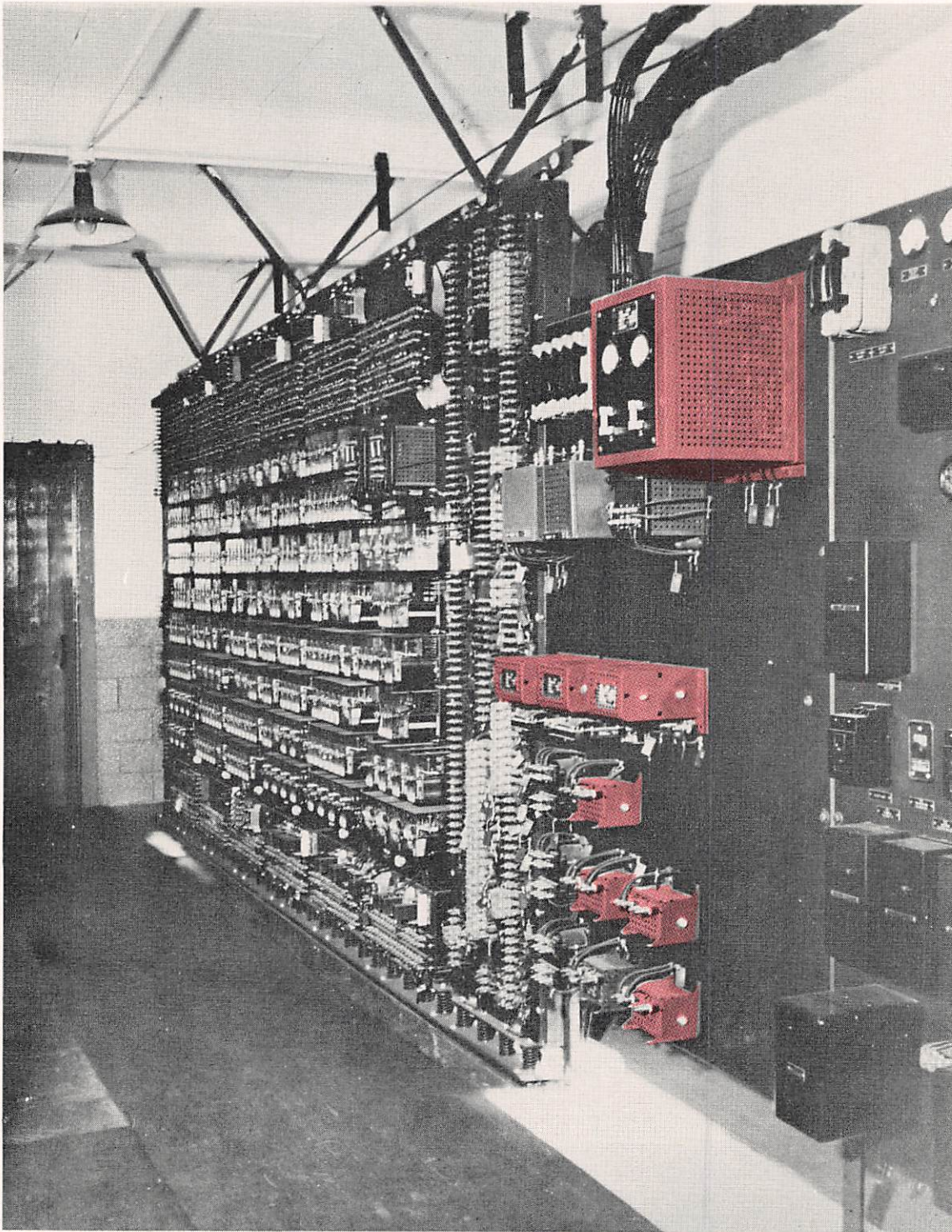


Figure 54. This typical installation has several G-R-S copper-oxide rectifiers of various types:

COPPER-OXIDE RECTIFIERS

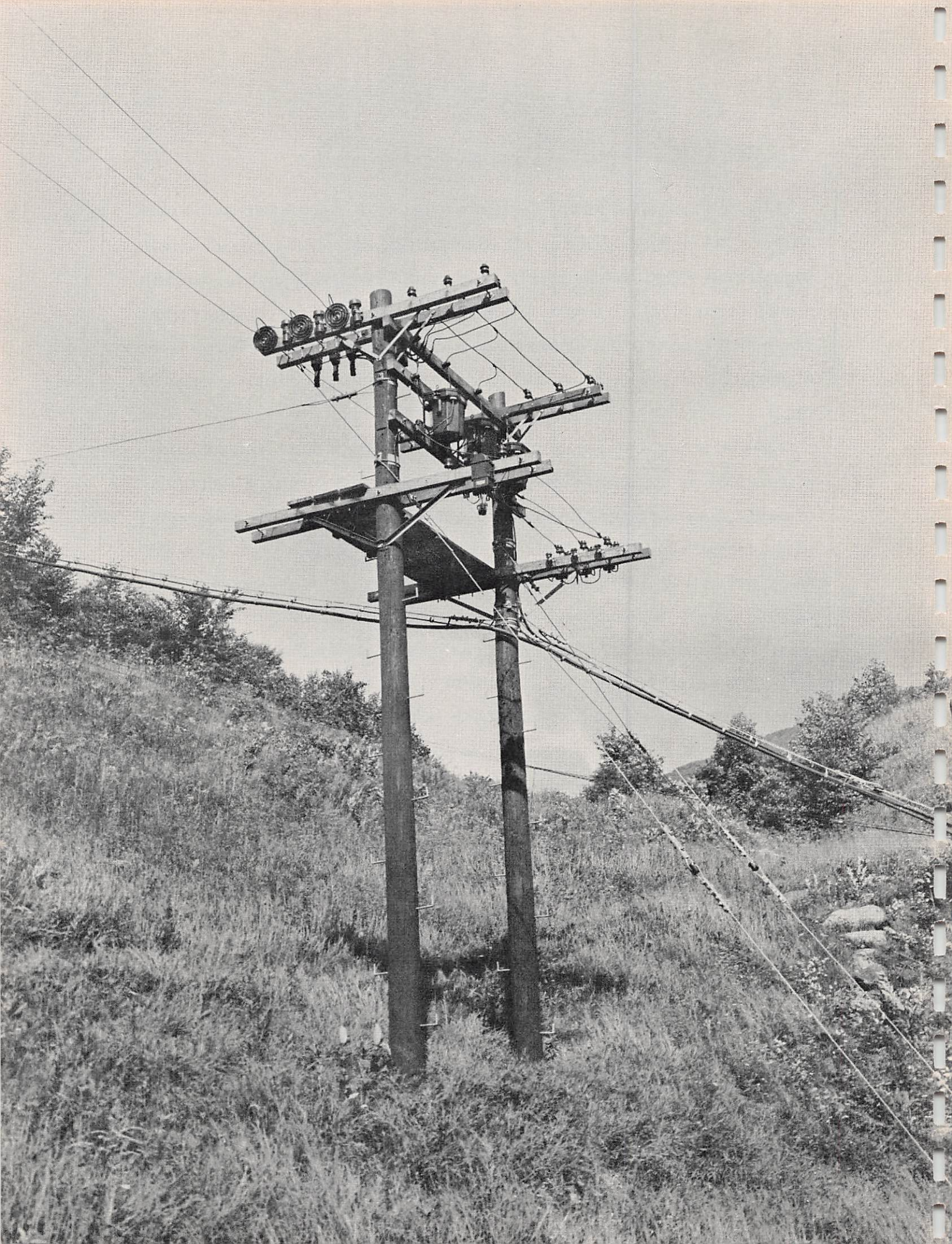
Figure 54 shows a few of the many types of G-R-S copper-oxide rectifiers. All G-R-S rectifiers are especially designed for railroad signaling service. They are available as a simple rectifying unit mounted in a perforated steel case with A.A.R. binding posts or as complete units combining tapped transformers and adjustable reactors. They provide dependable, trouble-free rectification with simple means for control of the d-c. output.

Careful selection of materials, close supervision during manufacture, and rigid final inspections and tests of each rectifier assure a high degree of uniform performance and long life in service. All current-carrying parts are insulated from their housings and supports so that they will withstand a ground test of 3000 volts a.c. between primary and secondary windings, thus isolating the a-c. line from batteries being charged. All rectifiers except large tower units can be wall or shelf mounted.

G-R-S rectifiers may be classified according to their use into five general groups: for battery charging, for operating d-c. relays, for sharing the load, for snubbing motors and for special applications.

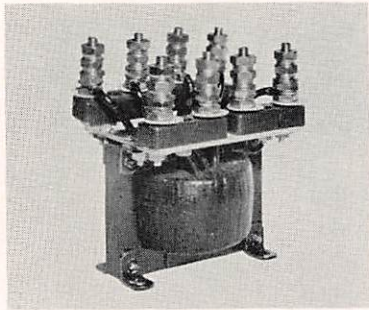
Each rectifying unit is made up of copper-oxide discs, lead washers, cooling fins, spacers, and insulating washers assembled on (and insulated from) a stud. The copper disc has on one face a coating of copper-oxide, which offers high resistance to electric current in one direction and low resistance to current in the opposite direction. This valve action or rectification takes place at the junction of the copper and copper-oxide. The output voltage and current requirements determine the number of discs and the way they are interconnected - in series and/or in multiple.

Our engineers will be glad to assist you in selecting the rectifier best suited to your needs.



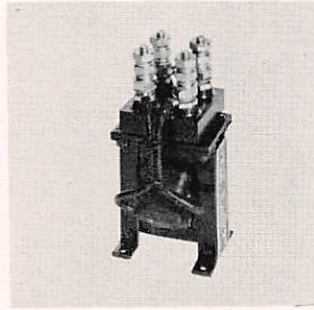
TRANSFORMERS

RAILWAY SIGNAL APPLIANCES



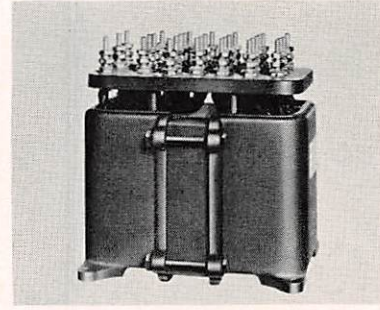
S1

0.060 KVA. ON 60 CYCLES
Transformer for small recti-
fiers, signal lighting.



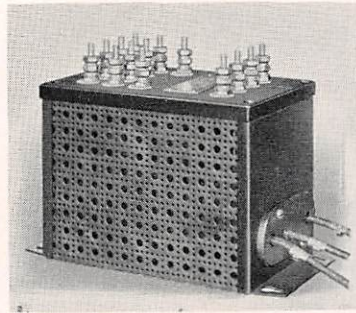
S2

0.005 KVA. ON 60 CYCLES
Transformer for track dia-
gram lights, lock lights.



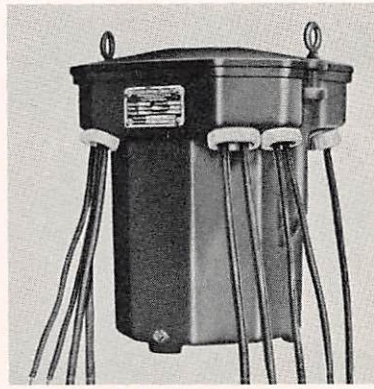
K2

0.600 KVA. ON 60 CYCLES
Transformer for signal light-
ing, battery charging, line
and track circuits.



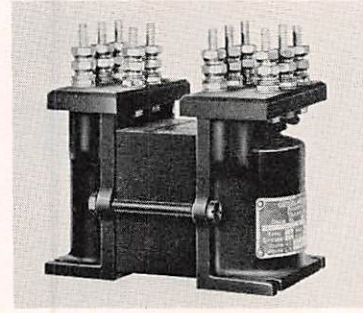
U1

0.300 KVA. ON 60 CYCLES
Transformer for signal light-
ing, battery charging, line
and track circuits.



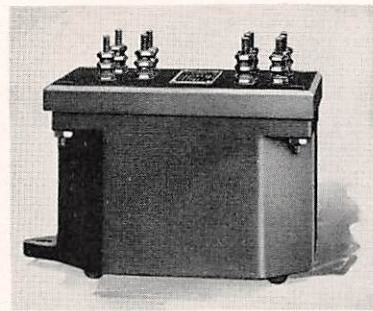
L1 to L6

UP TO 20.000 KVA.
ON 60 CYCLES
Transformer for stepping
down transmission line
voltage.



K1/2

0.100 KVA. ON 60 CYCLES
Transformer for signal light-
ing, battery charging, line
and track circuits.



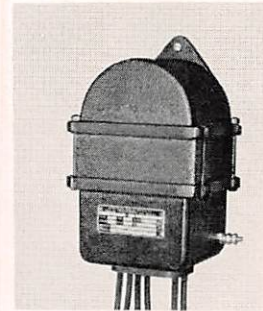
K1

0.300 KVA. ON 60 CYCLES
Transformer for signal light-
ing, battery charging, line
and track circuits.



K1 Pole-Mounted

0.300 KVA. ON 60 CYCLES
Transformer pole-mounted
for stepping down trans-
mission line voltage.



K2 Pole-Mounted

1.500 KVA. ON 60 CYCLES
Transformer pole-mounted
for stepping down trans-
mission line voltage.

Figure 55. G-R-S transformers are available in a wide range of sizes.

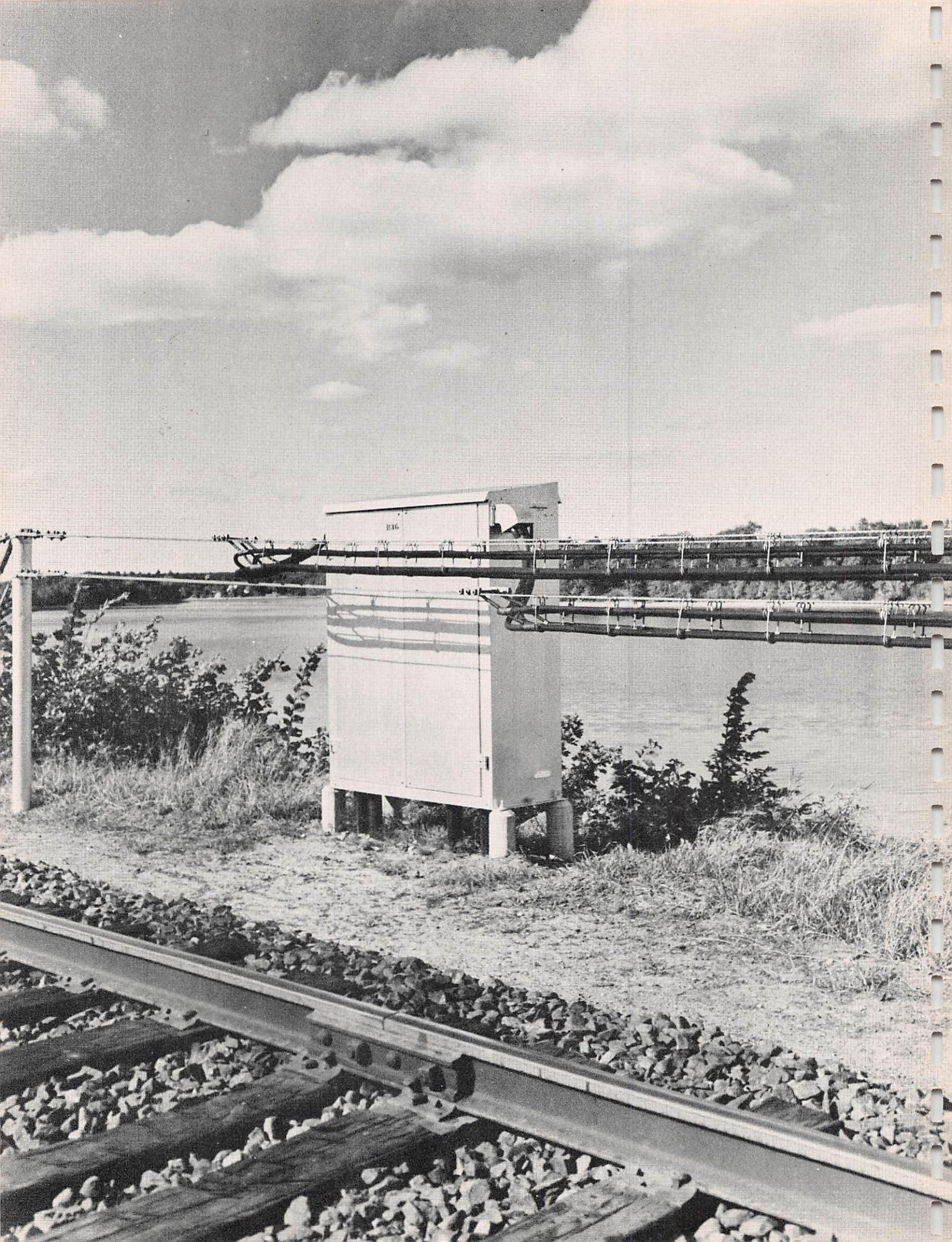
TRANSFORMERS

G-R-S single phase transformers, Figure 55, are made in a complete range of sizes from .005 kva. up to 2 kva., for a maximum of 600 volts at 60 cycles, in the air-cooled type. The capacities for the oil-cooled type range from .350 kv-a. to 20 kv-a. at a maximum of 5000 volts, 60 cycles. Any practical combination of windings, tap voltages, capacities, etc., can be furnished. Transformers may be designed for operation on any commercial frequency.

There is a variety of types, each with its particular application. Among the small air-cooled sizes are transformers for lighting, for track circuits, and for battery charging (using rectifiers); also weather-proof line transformers for use on low-voltage transmission lines. Oil-cooled transformers of high capacity are furnished for use on high-voltage transmission lines or for general use.

Oil-cooled transformers, see L1 to L6, Figure 55, have windings protected by weatherproof cast iron cases with suitable lugs for hanging. They have 5 and 10 percent reduced voltage taps on the high-voltage winding. If desired, reduced voltage taps can also be furnished on the low voltage winding. High tension leads and taps are brought to a porcelain terminal block, which is located below the oil level to protect against possibility of lightning arcs from post to post. Low voltage leads and taps are brought to a separate porcelain terminal block located above the oil level. High voltage leads are bared and sweated solid inside the case. They cannot siphon oil through the insulation and cable strands. All leads are imbedded in an insulating cement where they pass through the insulating bushings.

All G-R-S transformers feature low iron and copper losses, low magnetic leakage, good regulation and high resistance to breakdown.



CASES AND HOUSINGS

RAILWAY SIGNAL APPLIANCES

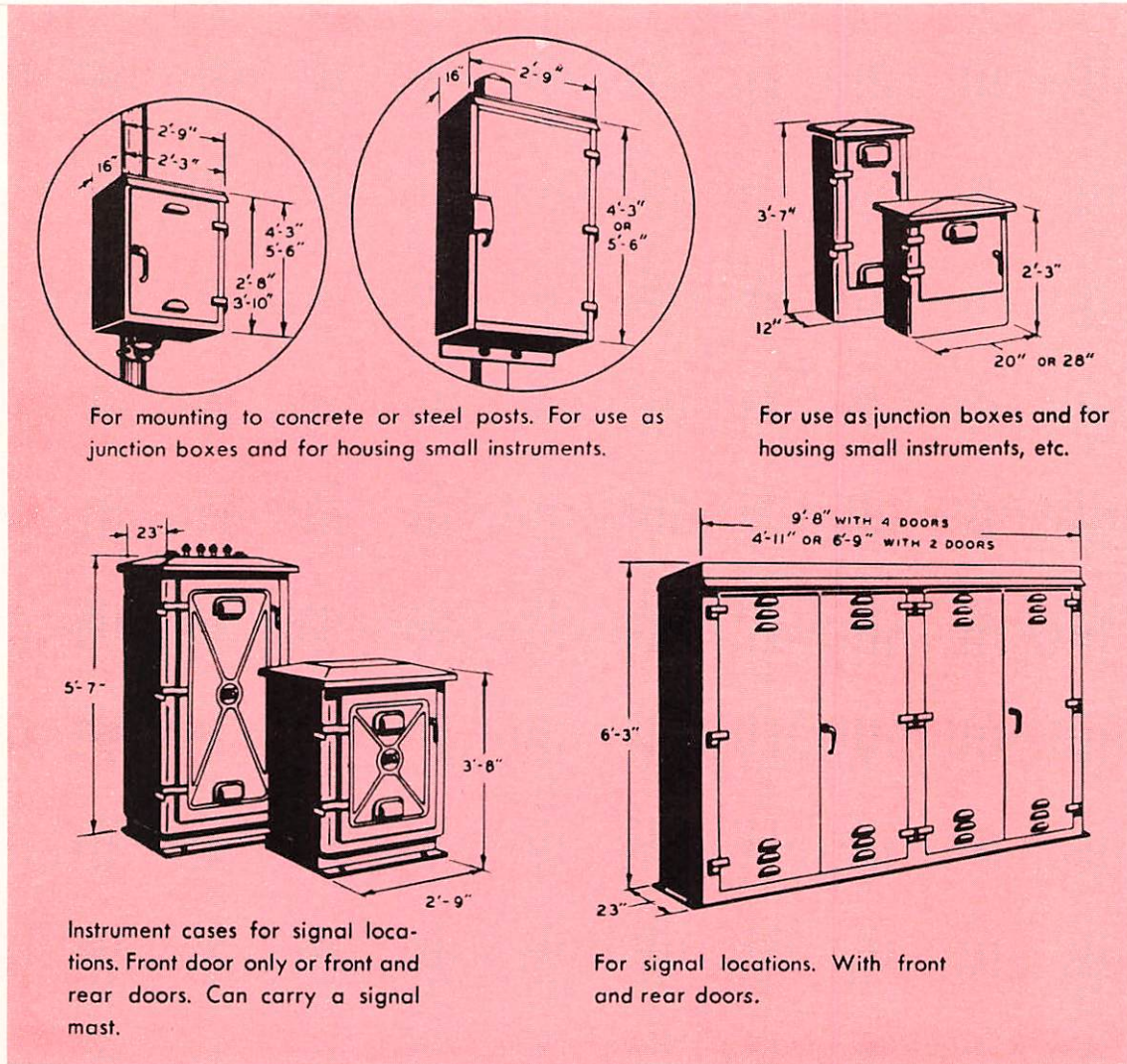


Figure 56a. G-R-S welded steel cases and housings.

CASES AND HOUSINGS

G-R-S welded steel cases and housings, Figure 56, provide economical protection for relays and other signaling apparatus. Many types and sizes are available to meet any requirement.

They are constructed of durable, copper bearing, rust resisting steel, welded into one sturdy unit. Insulation-board lining (optional) and tightly gasketed doors provide protection from weather and rapid temperature

CASES AND HOUSINGS

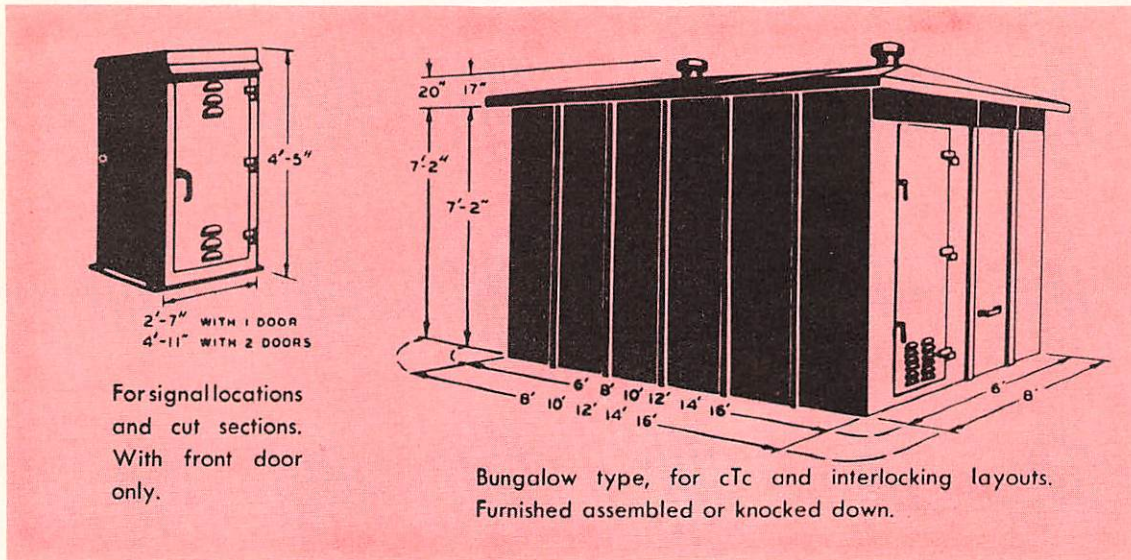


Figure 56b. G-R-S welded steel cases and housings.

changes. Door and roof ventilators are provided on all bungalow type housings. Roomy wire or cable entrances, aerial or underground, are located as best suits individual requirements.

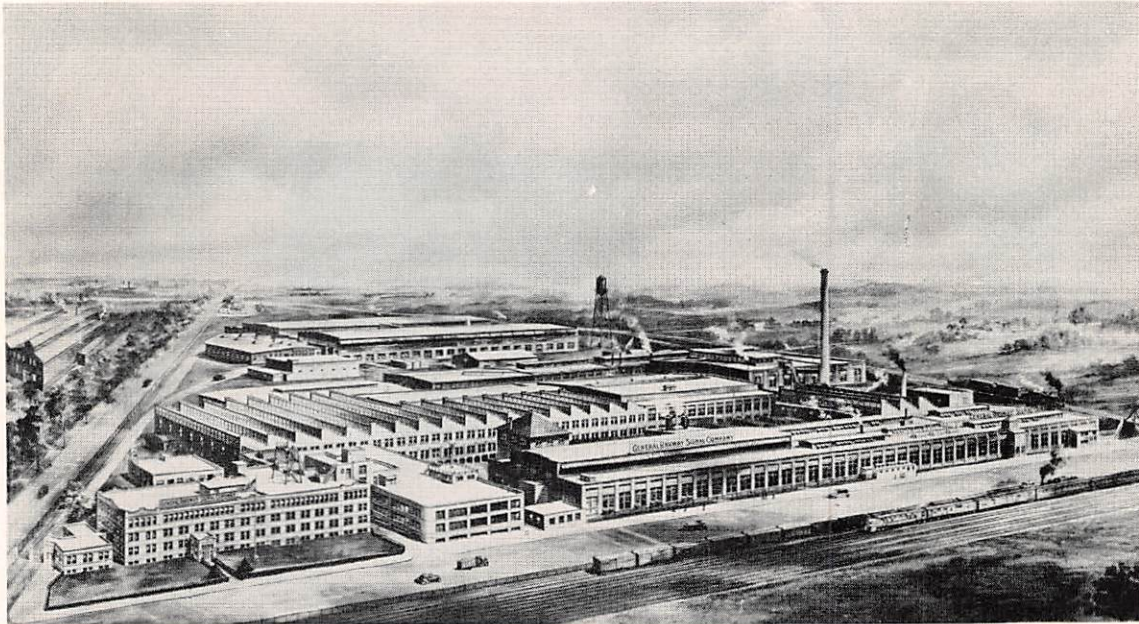
G-R-S welded steel cases and housings are light to handle yet have ample strength to meet any signaling need. They simplify maintenance by localizing work in a few units.

Optional features are: rubber floor covering, electric lights and outlets, telephone booth, and termite-proof apparatus mounting boards.

You can get cases and housings completely wired so that when delivered you just set them on precast foundations, make wire connections, and plug in the relays.

FOR MORE INFORMATION, STUDIES, ESTIMATES—

If you wish further information, please direct your inquiry to your local G-R-S representative or to the main office at Rochester, New York (see addresses on next page).



Main Office and Works, Rochester, N. Y.

Established 1904

GENERAL RAILWAY SIGNAL COMPANY

P. O. BOX 600, ROCHESTER 2, NEW YORK, U. S. A.

Telephone: GENesee 1483

Cable Address: GENRASIG, Rochester, N. Y.

DISTRICT OFFICES

NEW YORK OFFICE

230 Park Avenue
New York 17, New York
MUrray Hill 9-7533

CHICAGO OFFICE

122 South Michigan Avenue
Chicago 3, Illinois
HArrison 7-2361

EASTERN CANADIAN OFFICE

230 Park Avenue
New York 17, New York
MUrray Hill 9-7533

WESTERN CANADIAN OFFICE

122 South Michigan Avenue
Chicago 3, Illinois
HArrison 7-2361

ST. LOUIS OFFICE

611 Olive Street
St. Louis 1, Missouri
MAin 4696

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